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TECHNICAL REPOSITORY;

CONTAINING

Practical Information

ON SUBJECTS CONNECTED WITH

DISCOVERIES AND IMPROVEMENTS

IN THE

USEFUL ARTS.

ILLUSTRATED BY NUMEROUS ENGRAVINGS.

BY THOMAS GILL,

A CHAIRMAN OF THE COMMITTEE OF MECHANICS
IN THE SOCIETY FOR THE ENCOURAGEMENT OF ARTS, MANUFACTURES, AND COMMERCE, ADELPHI.

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TO THE

SECOND VOLUME.

The approbation and assistance which we continue to receive from persons of scientific and practical information, demand our warmest acknowledgments, and encourage us to renewed exertions.

We trust that the present Volume, like the former, will be found materially to assist the wants of ingenious Artists, to give birth to the more expanded views and inquiries of chemical and mechanical industry, *and to gratify the lovers of* general science. *And, inasmuch as the importance and love of the subject induced us, in the first instance, to undertake the work; so much the more, from witnessing the benefits it has already produced, are we anxious for its general diffusion: for which purpose we most earnestly invite the assistance, the communications, and the patronage, of all those who are sensible of the advantages derived from chemical and mechanical improvements to our national industry; and who are anxious to insure to Great Britain, a continuance of that superiority, which she, hereby, possesses over other countries.*

THE

TECHNICAL REPOSITORY.

I. — *On the Material and Manufacture of the Italian Bonnets, and the Habits and State of Society of the Manufacturers*.*

CHATEAUVIEUX, in his agreeable and instructive Letters, written from Italy, to M. Pictet, in 1812 and 1813, describes the persons who manufacture the Tuscan bonnets, and their state of society. In his sixth Letter, which is dated at Florence, are the following observations: (vol. I. p. 96.)

"The road I travelled was bordered on both sides by village-houses, whose distance from each other did not exceed one hundred paces. They are all built of brick; and the architect has bestowed upon them a justness of proportion, and an elegance of form, unknown in our climates. They consist of a single pavilion, that has often but one door and two windows in front. These houses are always situated along the road, and separated from it by a terrace and supporting wall, some feet in breadth. Upon this wall usually stand several vases of the antique shape, containing aloe-plants, flowers, and young orange-trees. The house itself is entirely covered by vine-branches; so that, during summer, one knows not whether they are so many pavilions of verdure, or dwellings prepared for winter.

"In front of these houses, swarms of young country-girls are seen, dressed in white linen, with corsets of silk, and

* From Vol. IV. No. I. of *Silliman's American Journal of Science and the Arts.*

straw-hats, adorned with flowers, inclining to one side of the head. They are constantly occupied in braiding the fine plait, the treasure of this valley, from which the straw-hats of Florence are made.

"This branch of industry has become the source of the prosperity of the Valley of the Arno. It produces, yearly, three millions (of livres); which are distributed exclusively among the women; for the men never engage in this occupation. Each young girl buys for a few pence the straw she wants: she then exerts her skill to braid it as fine as possible; and she herself sells, and for her own profit, the hats she has prepared. The money she thus earns constitutes her portion. The father of the family has nevertheless the right to require of the women belonging to his house, a certain amount of rustic labour on the farm. He receives this labour from the females of the Mountains (the Apennines), whom the girls of the Plains pay, out of the produce of their hats, for performing the tasks in their stead. One of them can earn from thirty to forty sous a-day in braiding her straw, while she can hire a poor Apennine woman to do her field-labour for eight or ten; and they secure, by this commutation of service, the delicacy and flexibility of their fingers necessary for their nice and fine work, and which would be spoiled by such exercises as harden and stiffen the hands.

"Such, Sir, are the female peasants of the Vale of the Arno; whose grace and beauty are so celebrated by travellers; whose language, Alfieri went there to study; and who seem, in fact, born to embellish the arts, and to furnish them models. They are shepherdesses of Arcadia, but they are not peasants: they possess only the health and freedom from care of that state, and never know its anxieties, its sun-burnings, and its fatigues.

"I have been informed that a crop of two acres is sufficient for all the straw of the hat-manufacture of Tuscany. This straw is the product of a beardless wheat, harvested before it is quite ripe, and whose vegetation is whitened

by the sterility of the soil. This soil is selected among the calcareous hills: it is never manured, and the seed is sown very thick. These habitations, so near to each other, shew of themselves that the domains to which they belong are very limited, and that property is remarkably subdivided in these valleys. In fact, the extent of these little plantations is only from three to ten acres. They lie around the dwelling, and are separated into lots by small canals and rows of trees. These trees are sometimes mulberries, almost always poplars, whose leaves serve to feed their animals. Each of them sustains a vine, whose branches the cultivator entwines in a thousand directions.

"These lots, laid out in long squares, are extensive enough to be cultivated by a plough without wheels, drawn by two oxen. There is one pair of these creatures among ten or a dozen of these tenants; and they are employed, in succession, for working all the farms in the connection. These oxen come from the states of Rome or Maremmes: they are of the Hungarian breed; and are exceedingly well kept, being covered with white cloths, decorated with a great deal of embroidery and with scarlet tassels.

"Most of these land-labourers keep a horse of a fine and elegant form. He is harnessed to a small two-wheeled cart, neatly constructed, and painted red. It serves for all the purposes of transportation on the farm, and more especially to convey the good man's daughters to the mass and the ball. Accordingly, on holidays, the roads are filled with hundreds of these little carts, moving in all directions, and carrying the young girls, adorned with flowers and ribbands.

"The farms of the Valley of the Arno have not forage enough to support cows: the cultivators, therefore, feed heifers only. These they buy at the age of three months, and keep them until eighteen, when they are sold to the butcher, and young ones bought in their places. It is from the pastures of Maremmes that the drovers bring the heifers to the fairs in the Valley of Arno.

"You will comprehend the motive for this practice, when I shall have explained to you the feeding system adopted in these valleys. There is no natural meadow. The leaves of the trees, the trash of the legumes, and a little clover, are the only feed for the animals. In this country, every thing is reserved for man, whose numbers have augmented beyond measure, under the most ancient civilization," &c. &c.

The plant, it will be remembered, of which the finest Leghorn bonnets are made, is a wheat,—varieties of the summer and winter wheat of the Arno.

II.—*On an Alternating Steam-Engine, invented by* MINUS WARD, *of South Carolina, United States.**

WITH A PLATE.

SIR, *Columbia, June* 1, 1821.

IT has long been a desideratum in Mechanics, to produce, by means of steam, a direct rotary motion. It has as long been the received doctrine, that to produce a rotary from a rectilinear motion, is attended with much loss of power, owing to what has been called the *reciprocation* of the moving mass: and "it was," therefore, to borrow the language of Mr. Sullivan†, "probably perceived to be a great object to get rid of the reciprocating movement of large masses, on the well-known mechanical principle, that it consumes power to check momentum, as well as to give it,—to drag an inert mass into motion rapidly, in opposite directions,"—or, as it has been more fully expressed by another writer, "to drag the inert mass from a state of rest to a state of motion, and from this state of motion to a state of rest."

To obviate this disadvantage, Mr. Watt, in England, and Mr. Curtis after him, in this country, endeavoured to give to the axis of the cylinder a direct rotary movement:

* From Vol. IV. No. I. of *Silliman's American Journal of Science and the Arts.*

† *American Journal*, Vol. I. p. 161.

but, owing in a great measure to the impossibility of confining the steam by packing upon corners, their attempts proved abortive in practice: and Mr. Morey, at last, invented a revolving engine, which, it was supposed, had completely triumphed over the difficulty of *reciprocation.*

It may seem hardy to question a dogma which has remained so long unquestioned; but I hold it equally pusillanimous never to think ourselves at liberty to examine received doctrines; and I hope you and your readers will, therefore, excuse my presumption, in endeavouring to shew, contrary to the received theory, that there is no loss of power in the reciprocating movement of the common steam-engine; and that the well-known principles of mechanics have been applied to the subject, under a misconception of the facts.

It is necessary, in the first place, to reduce to some more definite meaning, the phrases, "dragging the inert mass in opposite directions," and "dragging it from a state of motion to a state of rest." How and where does this "dragging" take place? The language here used can only mean, that the power of the steam, being exerted upon the reciprocating mass, in a direction opposite to that in which it is moving, overcomes its momentum, and causes it to stop. At what point, then, in the revolution of the crank, is the power of the steam thus exerted, and this cessation of movement effected? Supposing the crank to start from the upper dead-point, no such operation can take place at any point in the first half of the revolution; for nobody ever disputed, that, during this half, the power of the steam continues to be exerted, and the reciprocating mass to move, in the same directions which they respectively took at the commencement. That such a cessation of movements cannot be effected in the other half of the revolution—that is, after the crank has passed the lower dead-point—is equally clear, from the same consideration. And if, therefore, it takes place at any point in the whole revolution, it must be at the dead-point.

Thus explained, then, the theory above mentioned is this: that at the dead-point, the power of the steam being exerted upon the reciprocating mass, in a direction opposite to that in which it had been previously exerted, "checks its momentum", and causes it to stop. This proposition evidently assumes two facts: 1st, That, at the dead-point, the power of the steam is in full operation; and, 2dly, That, at the dead-point, the reciprocating mass possesses momentum, and indeed all the momentum which the power of the steam could give it, in the semi-revolution. Both of these assumptions I undertake to deny.

1. In their speculations on this subject, philosophers seem to have overlooked the mode in which a steam-engine must necessarily be made, if intended for any useful purpose. It is of the very essence of its construction, that not a particle of steam can enter the cylinder, when the crank is at the dead-point, either on one side of the piston or the other. And if there be no additional expenditure of steam, how can there be a further exertion of power? But, without resorting to this topic, is it not undeniable, as a general principle, founded on the very nature of things, that no power can be *reversed* in its direction, as it is here, without first ceasing to act? And, as the power of the steam is confessed to act both before and after the crank arrives at the dead-point, where else can it cease to act but at the dead-point, or, which is the same thing, the point of its reversion?—At the dead-point, therefore, the engine must be perfectly impotent.

2. The disproof of the second assumption seems to follow, as a corollary, from that of the first. It is acknowledged by all, that the reciprocating mass *does* stop at the dead-point; and what is this but another mode of saying, that it has ceased to have momentum?

If, then, the momentum of the reciprocating mass be not overcome by the power of the steam, how, and by what, is it overcome? The true explanation of these points will be found in the connexion of the fly-wheel with the recipro-

cating mass, by means of the crank. Supposing no other inert body to be connected with the engine, since we have just seen that the momentum of the reciprocating mass cannot be overcome by the power of the steam, of course there is nothing else which can overcome it, but the inertia of the fly-wheel. And the *modus operandi*, I take to be this:—The reciprocating mass and fly-wheel being connected through the medium of the crank, it results, from the principles of the crank, that the reciprocating mass is regularly and alternately accelerated and retarded: this retardation is gradual, and finally ends in total rest; after which the accumulation commences, and continues gradually until it arrives at its maximum. Now, during the retardation, the whole of the momentum, which existed in the reciprocating mass at the time of its greatest velocity, is gradually transferred to the fly-wheel; and, in like manner, during the acceleration, this same quantity of momentum is again transferred from the fly-wheel to the reciprocating mass*. It is this gradual transference of all the momentum of the reciprocating mass to the fly-wheel, and not the power of the steam "dragging the mass in an opposite direction," that "checks" its motion, and causes it to stop.

It seems to me, therefore, a work worse than nugatory, to waste ingenuity in devising modes of avoiding the *reciprocating movement*; and it has, I believe, invariably happened, that men of genius, while striving to shun this phantom, have encountered or overlooked real difficulties, which, if not fatal, have proved so serious a disadvantage to their respective inventions, as to render them entirely useless in practice. If there be any exception to this remark, it must be in favour of the revolving engine, invented by Mr. Morey. Much, however, as his ingenious machine appeared at first to promise, I apprehend it will be found, upon a short trial, that *he*, too, has neglected to

* This is also the opinion of Oliver Evans—Vid. "Abortion of the Young Steam-Engineer's Guide;" published in 1815.

provide against substantial difficulties, while endeavouring to get rid of such as were merely imaginary.

The great disadvantage in transferring momentum from a straight line to the circle, arises from the friction which necessarily attends the operation. When, for instance, the piston-rod is made to play in what are called *parallel guides;* and a connecting rod, attached to the cross-piece of the slides, gives motion to the crank; there are but two points in which the original direction of the power, and its direction as applied to the crank, coincide with one another. In all other points, the connecting-rod forms an angle with the guides; and this angle varies from the smallest which the construction of the engine will allow; being greater, as the crank-piece is longer, and less, as you increase the length of the connecting-rod. In all but two points, therefore, the power re-acts obliquely upon the guides; and, when the angle is the largest, the strain and friction are so great as not only to occasion a very serious loss of power, but to wear away the guides, and, by increasing the play of the sliders, to destroy, in a short time, the parallelism of the motion. The only mode of obviating any part of these disadvantages was, by having a short crank-piece, and a long connecting-rod. The greatest angle would then be small; the friction, of course, lessened; and the engine will stand a considerable length of time without need of repairs.

What, then, as it appears to me, will be found a serious, if not a fatal disadvantage in Mr. Morey's plan, is, that he is obliged to retain this parallel motion by guides. His engine, indeed, so far as this principle is concerned, is precisely the same with the common engine, which has the parallel motion by guides; the only difference being, that the point of action in the one, is the point of re-action in the other; a difference, however, which, in this respect, must be merely nominal, so long as action and re-action are equal. There is a real difference in another respect, that, in Morey's engine, the connecting-rod is necessarily so very short and the angle of action so great, that, though it may

answer the purpose for a short time, yet the loss by friction, and the frequent necessity of repairs, will more than counterbalance its neatness of construction and compactness of form.

Having devoted my life to the study of mathematics, both pure and mixed, and being a mechanic in practice as well as theory, I was led to examine the various methods which have been devised to render the power of steam subservient to the purposes of human life; and it occurred to me very early, in the course of my investigations, that the received supposition of a loss occasioned by the *reciprocating movement* was founded in error. Quitting, therefore, the idle pursuit of spending my time, and the ingenuity I might possess, in contriving ways to overcome a difficulty which did not exist, I was left to direct my undivided efforts to the invention of some machinery, which would avoid the real disadvantages of the old steam-engine, namely, its friction, bulkiness, complication, weight, and expense. To simplify and avoid friction were my sole objects; and I believe I have at length succeeded in combining the indispensable parts of the steam-engine, in such a way as to get rid of all the above-mentioned disadvantages.

In this engine, the piston-rod is also the connecting-rod. When applied to water-wheels, in propelling boats, the cylinder is placed within the water-wheel*. Two centre-pieces, firmly fixed to the boat, one on each side of the recess in which the wheel is placed, serve as axes to the wheel, the boxes of which turn on necks prepared to receive them: the centre-pieces, after traversing the boxes, are turned at right angles, and extend, within the wheel and towards its circumference, a distance equal to half the sweep of the piston: at this distance from the centre of the water-wheel, boxes are inserted in the centre-pieces, to

* I have thought the description would be more readily understood, if the alphabetical references were kept separate from the text. See the figure and its references, Pl. II. figs. 1 & 2.

of that which is described by the crank; then, of course, the length of piston-rod protruded, during the semi-revolution of this reduced circle, is equal to the length protruded when the crank is used; and the quantities of power consumed in each will be equal. That the effects produced will also be equal, may be shewn by taking a quadrant of the circle described by the crank, dividing it into a number of equal parts, and comparing the effects produced by the impulses at these points of division, with the effects produced by a like number of impulses at the circumference of the reduced circle. The pressure of the steam upon the piston being uniform throughout the stroke, it follows that the impulses at all points are equal to one another; and this being the case, it is equally a matter of course that the effects produced at the several points of division of the quadrant are as the perpendiculars respectively from those points to the line of force. The sum of the effects, then, will be equal to the sum of these perpendiculars: but these perpendiculars are as the sines of the angles at the several points of division; and, if the reader will take the trouble of adding together the natural sines for every degree in the quadrant, including radius, he will find their sum to be as nearly equal to ninety times the radius of the reduced circle, as the imperfection of our circulating decimals will admit. The formula would be this:—

Let the radius of the circle described by the crank = 1.

Then $\frac{1 \times 2 \times 2}{3.1415926}$ &c. $= 6366 \times 90 =$ the sum of the natural sines of the quadrant for every degree including radius.

As an objection particularly applicable to my engine, it has been suggested by some, who have seen the model, that the power is exerted at a disadvantage; from the circumstance, that the centre of re-action is within the circle of motion. Nothing is easier, than to shew, however, that, supposing, as we must, in all such comparisons, the length

and diameter of the cylinder, and also the elastic force of the steam, to be equal in each, the effect produced in my engine is equal to that produced in the Lever Engine.

Let the line DB (Plate II. Fig. 1.) represent the elastic force of the steam; the point D be the point of re-action; and the circle BKZ, the circle of motion. The force DB is resolvable into DE and EB, parallel and perpendicular respectively to the radius AB; and that part of it, which is exerted in the direction of the tangent, will be represented by the line EB. This is the force exerted in the Lever Engine.

In my engine B is the point of re-action; and LDM, the circle of motion. The force BD, in this case, is resolvable into BH and HD, parallel and perpendicular respectively to the radius AD; and that part of it, which is exerted in the direction of the tangent, will be represented by HD.

These two tangential forces, EB and HD, are to each other inversely as their distances from the common centre of motion A. For in the two triangles, ACD and AFB, the angle at A is common; and the angles AFB and ACD being right-angles, the remaining angles ABF and ADC are equal, and the two triangles similar. Therefore, BF (or HD) : DC (or EB) :: AB : CD. And inversely, HD : AB :: EB : AD.

But, from the properties of the lever, forces which are to each other inversely as their distances from the fulcrum, or common centre of motion, counteract each other, and produce an equilibrium: the two forces, HD and EB, therefore, would counteract each other; or, which is the same thing, produce equal effects.

The error on this subject has arisen from supposing an engine to operate upon the larger circle LDM from without its circumference, when, of course, the sweep of the piston would be equal to the diameter of the circle LDM; and then, comparing this engine with one on my plan, fixed at B, and with a sweep of piston equal only to

the diameter of the small circle BKZ. Taking it for granted that both engines would be of equal power, it was easy to shew, that the one on my plan would lose as much more power than the other, as the diameter of the large circle was greater than that of the less; but it was overlooked, that the two engines would consume steam and fuel exactly in the same proportion,—that my engine would consume as much less steam and fuel as its sweep of piston was less than that of the other,—that, in a word, the power consumed by my engine would be equal only to AB, while that consumed by the other would equal AD.

The advantages of my engine over the Lever Engine may be enumerated as follows:—1. The alternate transfer of momentum from the reciprocating mass to the fly-wheel, and *vice versa*, as above described, occasions a strain upon those parts of the engine which connect the alternating with the rotary parts; and this strain increases exactly in proportion as the time, in which it takes place, decreases; for, as you lessen the time, you increase the velocity, and, of course, the momentum. In the lever engine, this transfer takes place four times during every revolution; that is, the beam is accelerated and retarded during the first half of the revolution, and again accelerated and retarded during the other half. In my engine, the transfer takes place but twice in the whole revolution; that is, the cylinder is accelerated during one half, and retarded during the other. If, then, we suppose the revolution, in each case, to be performed in the same time, it follows, that two transfers of momentum occur in the Lever Engine, in the same time that one only takes place in mine; and that the velocity, momentum, and strain, at each transfer, are twice as great as in mine. The strain is also greater, from two other circumstances; first, because the weight of the cylinder, which is the body accelerated and retarded in my engine, is not so heavy as the beam; and secondly, because it is placed nearer the centre of motion than the parts of the beam. 2. As the steam contained in the

tubes, extending from the cocks to the ends of the cylinder, is necessarily lost at each revolution, the shorter these tubes are the better; and the cocks being placed, in my engine, on the sides of the cylinder, the aggregate length of these tubes is no greater than the length of the cylinder itself. 3. The friction is much diminished, both because fewer pieces of machinery are employed, and because the action and re-action are sustained by gudgeons, which always revolve the same way; except those of the cross-piece at the head of the piston-rod, which have a vibratory motion. 4. There being less use of steam, of course less fuel will be necessary: and this is not only a saving of expense, but of room also, and freight; since it is well known, that the bulk and weight of the wood consumed, in the common steam-boats, cause a material drawback on the profits of these establishments. 5. Many of the old pieces of machinery being got rid of, my engine is less bulky, a great deal lighter, much less expensive, and more durable than any other. 6. There is a very great saving of room in placing the engine within the water-wheel. 7. If there be a water-wheel on each side of the boat, with steam-tubes extending to each, the boat may be turned about with great facility, by merely shutting the throttle-valve belonging to the one wheel or the other, according as you wish to turn to the one side or to the other.—I have not thought it worth while to extend this article, by specifying the many little practical matters which will occur in the construction of my engine; such as, the mode of supplying the parts with oil; of casing the cylinder, so as to exclude it from the water of the wheel; &c.

References to the Figure, Pl. II. *fig.* 2.

a. Piston-rod.
bb. Cylinder.
cccc. Water-wheel.
dd. Adjacent parts of the boat.
e & *f.* Parts of the centre-piece.

g. Gudgeon of the cylinder.
h. Neck on which the water-wheel turns.
i & *k.* Beginning and end of the induction-tube.
l & *m.* Same of the eduction-tube.
n. Stationary part of the cocks.
o. Moveable part of the same.
p. Cross-piece attached to the piston-rod.
q. Gudgeon of same.
rrrr. Arms of the water-wheel.
ss. Rods, playing through steps in the cylinder.
tttt. Rods.
uuu. Steps.

III.—*On New and Improved Lutes and Cements. By Mr.* JAMES DEVILLE.—*In a Letter to the* EDITOR.

SIR, 367, *Strand, June* 12, 1822.

THOSE manufacturers who are concerned in the use of plaster of Paris have long been acquainted with cements of the nature of that published by you as *Varley's Cement*; the chief difference being, that *plaster of Paris*, mixed with resin and a little bees'-wax, is employed instead of whiting or chalk; and it is preferred, on account of its being freer from moisture than either of the other substances.

I have found the following lute or cement of great use in many cases, but particularly for closing the joints of the apparatus during the very extensive course of experiments which I have made on the production of *oil-gas*. It is prepared as follows:

Take equal parts, by bulk, of white-lead ground in linseed-oil (as sold in the colour-shops) and plaster of Paris, and well knead them together just before using the cement; and, when every thing is ready for joining, add a little water to it, more or less, as the cement is required to be thicker or thinner, and apply it immediately. In a few minutes it will

set; and it is astonishing how very hard it becomes in the course of a few days.

Hoping that this lute or cement (which is entirely of my own inventing, and the result of necessity, in not finding any of those usually employed to answer my purpose) may prove as useful to others as I have found it to be in my own pursuits. I remain, Sir, yours respectfully,

JAMES DEVILLE.

IV.—*On a New Blow-pipe. By Professor* JACOB GREEN, *of Nassau Hall, Princeton, U. S.**

WITH AN ENGRAVING.

THERE is scarcely an instrument in the laboratory which has undergone so many varieties in construction as the blow-pipe: both the chemist and the artisan are in possession of a number: but the great inconvenience I experienced in using the common mouth blow-pipe occasioned the contrivance I shall presently describe. The power of keeping up a constant stream of air with this instrument, and which is so essential, is with difficulty acquired, and is always fatiguing, if not injurious, when continued for a length of time†. In those experiments which require the free use of both hands, this cannot be employed; and the enameler's blow-pipe, which is then resorted to, is cumbersome and expensive. To obviate these difficulties, and to make a blow-pipe cheap and portable, which may be applied with facility to purposes that require both hands to be left at liberty, has been my design in this communication; and in completing it, there will be found but little novelty, either in the principle on which it acts, or in the mode of its construction.

* From Vol. IV. No. I. of *Silliman's American Journal of Science and the Arts.*

† We apprehend that many of the objections to the use of the mouth blow-pipe are much lessened, if not entirely removed, by the blow-pipe described in our First Volume, p. 247.—EDITOR.

Plate II. Fig. 3. represents the instrument, made of copper or iron tinned, and covered with a thick coat of paint to prevent rust or oxidation. It consists of two principal parts:—A A A is a large cylindrical vessel for the purpose of containing the water by which a portion of *atmospheric air* is confined; but to diminish the weight which a large quantity of water would occasion, a smaller vessel, B B, close at the top, of the same shape as the exterior cylinder, is soldered to the bottom of A A.—C C is another cylindrical vessel, designed to contain the air, and made with its bottom open, so as to slide easily between the inner and outer cylinders A A and B B; a small quantity of water being added, to fill up the space between them. Round the bottom of C C is a rim of lead, to sink the vessel in the water, and compress the inclosed air; and on the top there is a stop-cock, F.—From another stop-cock, G, on the outside of A A, there runs a tube down under the apparatus, and then rising through the interior cylinder BB, and its top at H, (the opening by which it passes being soldered so as to be air-tight). On the outer part of the stop-cock, G, is cut a screw; to which can be applied various caps, one of which is shewn at I, when apertures of various sizes are wanted.

To use the instrument, the cylindrical vessel, C C, is taken out from between A A and B B; the stop-cock, F, shut; and a sufficient quantity of water poured between the outer and inner cylinders. C C is then adjusted in its place, the cock G being closed. The vessel, CC, descends, by reason of its gravity; and the atmospheric air is forced, by the pressure, through the opening H, down the tube H K, and out at the orifice G, when the stop-cock G is opened; and thus a continued and uniform jet of air may be thrown on the flame of a lamp placed before G.

The caps, I, are about half an inch long; have a female screw at one end, to fit on the male screw at G; and are perforated with different-sized apertures at their other ends, to regulate the jet of air. When the air in the cylinder C is

exhausted, or when it has descended as far as possible, the stop-cock F is opened to admit the air, and the vessel is drawn upwards, by the handle L, as far as convenient, when the stop-cock F is again closed.

A valve, opening downwards, may be substituted for F;* but, though this is more convenient for a time, it is more likely to get out of repair. The instrument I use will supply an ordinary jet of air for five minutes, while the cylinder C descends once. Mr. Pollock, an ingenious mathematical-instrument-maker, at Boston, has used it with success for some time.

By a little additional apparatus, it can be used as a gasometer; by means of which, the cylinder C C may be filled with oxygen or other gas: in this case, C must be suspended by cords over pulleys, and counterpoised by a weight. It will be unnecessary to go into a description of the manner of filling this with gas; as, in this form, the instrument differs very little from the common gasometer.

V.—*On Welding Cast-Steel to Iron. By Mr.* WILLIAM THURNALL.—*In a Letter to the* EDITOR.

SIR,

OBSERVING in your valuable publication, "The Technical Repository," a mode of welding cast-steel to iron, I am induced to communicate the result of several experiments which I made some time since, to effect this purpose.

In the operation of welding it being necessary to bring the bodies which are to be united into a state of partial fusion, and as heating the cast-steel sufficiently for that purpose frequently destroys it altogether, it occurred to me that some chemical agency might facilitate the union. I tried the fixed alkalies with powdered silex, and a variety of other things, but have found nothing answer so well as *sulphur*, either by itself, or in combination with fixed alkali.—

* Or, which would be still better, one or two valves opening upwards, made on the top H, of the vessel B.—EDITOR.

I also tried borate of soda (borax), with sulphur; but I think the result was in favour of sulphur by itself.

The management is extremely simple: nothing more is requisite than bringing the iron nearly to a welding heat, and giving the steel that degree of heat which it will bear without injuring its quality; having upon the forge a small quantity of the flowers of sulphur. While in this state, the two surfaces to be welded are to be instantly drawn across the sulphur, which immediately produces a superficial fusion, and applied with as much celerity as possible to each other, hammering upon the anvil in the usual manner. —I have tempered the steel when united in this way, and can perceive no deterioration in its quality.

I am, Sir, your obedient humble Servant,

Duxford, near Cambridge, June 1, 1822. WM. THURNALL.

VI.—*On the Aphlogistic or Flameless Lamp. By Dr.* J. L. COMSTOCK, *of Hartford, Connecticut, U.S.**

WITH AN ENGRAVING.

IN the construction of this lamp, the object is, to keep a coil of wire in a state of permanent ignition, without either flame or smoke.

The principle on which it is constructed was, I believe, first discovered by Sir H. Davey. He found, that on heating a coil of platina wire red hot, and instantly holding it near the surface of some ether placed in a wine-glass, the wire was kept at a red heat, as long as the experiment was continued.

Whether Sir Humphrey pursued the subject any farther, I am not informed. It is most probable, however, that he did not; as it is stated in a London Paper of the last year, that Professor Ure, of Glasgow, had determined the circumstances which modify the performance of the lamp; and that one constructed by him was in full action in that city (London), and had excited much public curiosity.

* From Vol. II. No. 2. of *Silliman's American Journal.*

This notice contains, some directions, concerning the size of the wire, and the manner of coiling it. I have, however, seen no description of this lamp which would enable one to construct it. The following, therefore, may interest such readers as have seen no account of this curious discovery*.

The principle on which the aphlogistic lamp is constructed involves two conditions, which are absolutely requisite; viz. that we make use of a combustible substance which evaporates at a low temperature, and a metal which is a bad conductor of caloric. For the combustible, *alcohol*, seems best suited to the purpose. *Sulphuric ether*, in addition to its high price and disagreeable smell, I have found sometimes to fail; the ignition ceasing without any obvious cause. In regard to the metal, *gold* and *silver* both fail, in consequence of the rapidity with which they conduct caloric. Silver, too, would be destroyed by the intense heat.

Iron, although so bad a conductor as to remain ignited for a time, soon fails, being converted into red oxide.

Platina seems to be the only metal adapted to this purpose, being comparatively a slow conductor of caloric, and not easily oxidated at the highest temperatures. This is to be drawn into wire of the diameter of $\frac{56}{100}$ or $\frac{60}{100}$ of an inch†. Experience has shewn that this size succeeds better than any other. If larger, the heat is carried off too rapidly, and ignition ceases in a few moments. If much finer, it does not retain sufficient heat at the lower part of the coil to keep up the evaporation of the alcohol from the wick. The coiling of the wire, and the adjustment of the wick, are the most difficult parts of the construction.

The coil A (see Plate II. fig. 4.) is made by winding the wire round a piece of wood, cut of the proper size and

* The Editor of this work was the first to give to the Public an account of this *flameless lamp* in the Annals of Philosophy, *in the beginning of the year* 1818: some little improvement, however, in the manner of fitting it up, has induced him to publish this American account of it.—EDITOR.

† This must surely be a *mis-print*, as such wire would be more than *half an inch* in thickness: possibly it should be $\frac{1}{56}$ or $\frac{1}{60}$ of an inch. The Editor found that *the one hundredth part of an inch* was the fittest size; and it will appear, from the sequel, that this is about the size employed.—EDITOR.

shape. The size is determined by the bore of the glass tube, allowing for the diameter of the wire. The shape, in that part which enters the tube, is plain cylindrical, but slightly conical where it projects above the tube. (I believe this is the best shape; though I have succeeded equally well when the coil was of the same shape throughout.)

In winding the coil, it is best that the turns of the wire should come into contact. Afterwards, it is to be gently extended, so as to leave the turns as near as possible to each other, without touching.

The diameter of the coil is about one-sixth part of an inch, where it enters the tube: its length, *half an inch*, or a little less, containing *from twenty to thirty turns of the wire*. The projection above the tube is rather less than one half the length.—B is a glass tube, containing a cotton wick, which, by capillary attraction, carries the alcohol up to the platina coil. The length of this tube is arbitrary, being from one inch to three or four inches. The bore is about one-sixth of an inch, so as barely to admit the coil. The wick, consisting of eight or ten threads, is first drawn through the tube, and then introduced about half way into the coil, so as to come nearly even with the top of the tube. This requires very nice adjustment. If the wick be too high, the wire is rapidly cooled by the alcohol, and ignition soon ceases: if too low, the evaporation by the heat of the wire is insufficient. If, however, the other parts are well constructed, a few trials will insure success.

The body of the lamp is a low phial, or glass ink-pot, capable of holding about two ounces of alcohol. It is stopped accurately with a cork, which is covered, for ornament, with tin-foil. The aperture for admitting the tube and wick is made with a hot iron. D is a small tube through which the alcohol is poured. A *dropping-tube* is convenient for this purpose; but a small funnel is easily made, by cutting off an inch of the neck of a broken retort, into which is pushed a cork, and through this a small quill. Another orifice still, for letting off the air as the alcohol goes in, may be made through the cork. After the lamp is

charged, these orifices, of course, are to be closed, to prevent evaporation.

When the lamp is completed and charged, the alcohol is inflamed by holding the coil in the blaze of a candle. After letting it burn for a minute or two, the flame is blown out; when, if every thing is properly adjusted, the wire will continue red hot until the alcohol is exhausted.

The explanation, why the ignition of the wire is permanent, seems to be sufficiently simple. Alcohol, when in the state of vapour, combines with oxygen with great facility. The temperature of the wire is first raised, by the flame of the candle, to about 800° Fahr. This degree of heat is such as to effect the combination of the alcohol with the oxygen of the atmosphere. When this is once effected, the caloric extricated by the combustion of the alcohol is sufficient to keep the coil at a red heat, which again is the temperature at which the alcohol is combustible: so that one portion of alcohol, by the absorption of oxygen, and the consequent extrication of caloric, lays the foundation for the combustion of another portion; and, as the alcohol rises in a constant stream, so the effect is constant. The stream of vapour is much increased by the heat of the lower part of the coil, where it embraces the wick; and the temperature of the vapour is considerably raised before it reaches that part of the coil where its combustion is effected. Sometimes, the last or upper turn of the wire only is kept red hot.

This lamp, though one of the most curious inventions of the age, is not merely a curiosity. The facility and certainty with which, by means of a match, a light may be obtained from it, constitutes its utility. The proper matches for this purpose are prepared by dipping the common brimstone matches into a paste made by mixing two parts of white sugar with one part of chlorate (oxymuriate) of potash*. The red French matches are of this kind, and answer the purpose completely.

* This composition is liable to *deliquesce*. A far better preparation is given in p. 249 of our First Volume; and, especially, when lycopodium is substituted in place of starch.—EDITOR.

Remarks by Editor of Technical Repository.

We have succeeded in forming this Aphlogistic Lamp, according to the instructions here given, but with a platina wire of the $\frac{1}{100}$th part of an inch only in thickness; and have kept it burning for twenty hours, with a supply of only one liquid ounce of alcohol. The improvement consists in inclosing the lower part of the coil of platina wire as well as the cotton wick within the glass tube; instead of letting a part of the cotton wick protrude, and placing the lower part of the wire coil upon it.

As the oxygenated matches, when they explode in kindling, are apt to oxydate the platina wire, injures its action, and frequently extinguishes it: it is better to kindle a little *amadou*, or German fungus, and with that inflame a common sulphured match; or to provide sulphured matches, having minute portions of amadou stuck on their points by fusing the sulphur, and thus obtain light at once.

In cases where a light might be wanted, but a constant one would be offensive, this lamp would be a great convenience; a light being almost instantaneously obtained by touching a match to the platina coil, and then to the wick of a candle. Physicians, or others who are liable to be called up in the night, would find it convenient.

VII.—*On Tests for the Discovery of Arsenic, by* THOMAS COOPER, M. D. *Professor of Chemistry, and acting President in the College of South Carolina.—To which are subjoined, Explanatory Observations, by Dr.* T. D. PORTER, *a Tutor in the same Institution.**

REMARKS.

DR. PORTER's Dissertation, from which some experiments were cited in Vol. III. p. 354, of this Journal†, was evidently not intended for publication; but, as inaugural dissertations of Medical graduates are held liable to publica-

* From Vol. IV. No. I. of *Silliman's American Journal of Science and the Arts.*

† See Vol. I. p. 365 of this Work.

tion, and are in most Institutions actually published, the Editor, although Dr. Porter was at the time in South Carolina, did not hesitate to quote some facts, which appeared to him worthy of notice. He does not regret the step, especially as it has been the means of drawing from Dr. Cooper the following valuable Letter.—Dr. Porter happening to be here (New-Haven) at the time of its reception, it was thought no more than fair to shew him the Letter, and to receive his reply, which is annexed.—*American Editor.*

Columbia, South Carolina,
DEAR SIR, *Aug.* 13, 1821.

I observe in the May Number of your Journal, p. 354, a summary of experiments on the Tests for Arsenic, by Dr. T. D. Porter, one of the tutors of the South-Carolina College here. They are intended to shew, 1st, That the green colour produced by the union of arsenious or arsenic acid and copper may be produced from copper, by onion juice, by coffee, and more especially by chromate of potash, without the aid of arsenic; of which, therefore, that green colour is no exclusive indication. 2dly, That in the production of Schéele's green by sulphate of copper, carbonate of potash, and arsenic,—*chromate of potash* may be substituted for the arsenic, producing a precipitate not to be distinguished by the eye from Schéele's green. 3dly, That the yellow precipitate produced in a solution of arsenite of potash, or arsenious acid, by Mr. Hume and Dr. Marcet, may be produced by substituting chromate of potash for the arsenical solution: so that this test also is fallacious. The subject is of importance; and it is well that any mistakes or oversights, to which all of us are liable, should be corrected. I have carefully repeated all Dr. Porter's experiments, since I saw your summary of them: and I should have been glad to have repeated them with Dr. Porter himself, applying not only the other tests of arsenic, but also my own test of chromate of potash, which I do not find that Dr. Porter has noticed, among the

methods of discovering the poison in question. I should have been much gratified to have been made acquainted with the ambiguities which occurred to Dr. Porter, and with his dissertation on the subject; for, in such case, both his experiments and my own might have been made more satisfactory.

To the first class of Dr. Porter's cases, I object, (*a*) That although a greenish colour may be produced by onion juice, and by coffee, with a solution of sulphate of copper, it is so dingy, and so different from Schéele's green and from chromate of copper, that the most inexperienced eye need be under no mistake. (*b*) That Dr. Bostock's proposal of Schéele's green as a test of arsenic has never been relied on as decisive by any other chemist of authority. (*c*) That it is utterly impossible for any *chemist* to be led away by the ambiguity of colour produced by Dr. Porter's re-agents; as a single drop of ammonia will instantaneously detect the copper, in all these experiments. —A source of error so very easily discovered, is, in fact, no source of error at all.

To the second assertion, I object that the statement in your summary is not quite accurate as a matter of fact.— Take sulphate of copper; precipitate by carbonate of potash; add chromate of potash in the way you cite the experiment;—a green colour will be produced, exactly like Schéele's green: so it will if you add infusion of turmeric, or gamboge, or saffron, or any other liquor equally yellow, with the chromate of potash: but this superinduced yellow colour can be washed away completely, and the carbonate of copper will resume its original blue tint; no chromate of copper is formed, no chemical union has taken place; the colour is a mere optical deception, that can impose upon no chemist. *But*, if to a strong solution of sulphate of copper you add an equal quantity of chromate of potash, of the strength usually employed by the manufacturers of chromic yellow, you will produce a green chromate of copper, that will retain its colour unchanged by repeated

solution. Chromate of potash, therefore, cannot be *substituted* for arsenic, if the experiment be made as Dr. Porter has directed. I acknowledge, however, that I should have remained ignorant of the green colour produced by the admixture of sulphate of copper and chromate of potash, if Dr. Porter's experiments had not led me to it.

To the third statement of Dr. Porter, I object, that it is not conformable to my experience. Take a solution of arsenious acid or of arsenite of potash, dip a slender glass rod in a solution of nitrate of silver and another in ammonia, bring them near together, and immerse them in the arsenical solution, as Dr. Marcet directs; in this case a dense yellow precipitate will appear. In lieu of nitrate of silver, take chromate of potash, as Dr. Porter directs: the result *will not be the same*; a yellow tint will be given to the liquor, owing to the yellow colour of the chromate of potash, but no precipitate will take place. If the arsenical solution be strong, and the chromate of potash be added in equal quantity, or somewhat more, the yellow tint will, in half an hour, become green, owing to the arsenious acid robbing the chromic acid of a part of its oxygen; the arsenious being converted into the arsenic, and the chromic acid into the chromic oxide. But I aver, that it is utterly impossible to confound the dense yellow precipitate produced in Dr. Marcet's experiment, with any of the appearances produced by Dr. Porter's substitute of chromate of potash. Again, Take chromate of potash, diluted or not diluted, as you please: operate on this chromate of potash, as Dr. Marcet directs you to operate on the arsenical solution; that is, dip a glass rod in a solution of nitrate of silver, and another in ammonia; bring them near together, and immerse them in the solution of chromate of potash, as you would in an arsenical solution;—the precipitate will assume the *brown* tinge of chromate of silver, perfectly different from the yellow arsenite of silver. Dr. Porter may have a method of performing the experiment, not suggested in your summary; but if it be intended to

form an objection to Dr. Marcet's test, Dr. Marcet's process should be followed.

I used, in these experiments, a chromate of potash made in the imperfect and impure way in which Dr. Porter used it; and also another solution made in the usual way: that is, I took two ounces avoirdupois of triturated chromated iron, and added to it one ounce avoirdupois of triturated nitre: to other two ounces avoirdupois of chromated iron, I added one ounce of dried salt of tartar. I exposed them, in separate crucibles, to a full red heat, for one hour (side by side) in a common forge: I washed the contents of each crucible in the same quantity of boiling water, and filtered. On testing them with superacetate of lead, the yellow produced by the nitrated chromate of iron was of a richer colour than the other; which last contained not only uncombined alkali, but also a portion of oxide of iron, which covered the precipitate of lead: but, in making the experiments detailed in this Paper, I found no perceptible difference of result between the two solutions. In this variance between Dr. Porter's experiments and mine, it is desirable that other persons should repeat them; and with this view I transmit to you these remarks. The subject ought to be investigated in every point of view, until our chemists are enabled to say before a court and a jury, "We *do* possess sure and accurate means of detecting the poison of arsenic."

Of the methods hitherto proposed for this purpose, the following appears to me to be the best—deduced from the result of my own experiments, and of the chemists who have preceded me.

Suppose a man suspected of being poisoned by arsenic: let the ejections from his stomach (and the contents of his stomach, if dead) be examined carefully with a magnifying glass, to discover the particles of white arsenic in substance, which should be set aside for experiment. If you find no such appearance, let the matter ejected, and contained, be fully dried in a heat of not less than 100° Fahr.

Take some of the dried matter: triturate it with $\frac{1}{10}$th of its weight of *dry* lamp-black, ivory black, or charcoal; into a glass tube, six or nine inches long, half an inch wide, and closed at one end, put as much of this mixture as will fill the tube from half an inch to an inch deep; stop the open end lightly with a cork; expose the matter in the flame of an oil or spirit lamp; and if there be any arsenic, it will shortly sublime, in black shining metallic particles, toward the upper end of the tube. These, when collected, will exhibit the white stain when treated with copper; and the garlic odour, when thrown upon hot coals, which is peculiar to arsenic. If this appearance takes place in the tube, you need proceed no further, unless to make security doubly sure.

Take another sufficiently large portion of the dried matter: boil it in rain or distilled water for one-fourth of an hour, in a Florence flask, or other convenient vessel. Filter; concentrate the filtered solution; and keep it for experiment. Take of this filtered solution three portions, in three separate wine-glasses, or clear watch-glasses: drop into one portion a few drops of carbonate of potash, to saturate the arsenious acid; then add a drop or two of sulphate of copper: if a green precipitate appears, it affords strong *prima-facie* evidence of the presence of arsenic.

Take another portion of the filtered solution: drop into it a few drops of chromate of potash: wait half an hour: if a bright grass-green colour is produced, it forms another evidence that arsenic is present. To this green solution add a drop of ammonia: if no blue colour be produced, *you may rest assured* that the green colour is produced, not by copper, but by arsenic. I trust with confidence to this test, which detects the twentieth part of a grain of arsenic, whether in powder or solution.

Take the third portion: try it with nitrated silver and ammonia, *in the manner directed by Dr. Marcet.* If a dense yellow precipitate appears, there is surely arsenic. The

filtered solution may be tried in the first instance for copper, by a drop of ammonia, which will disentangle you at once from Dr. Porter's ambiguities; for a glass rod dipped in ammonia, like the touch of Ithuriel's spear, will make the copper start up at once in its true colour. Nor, indeed, is it likely that the crime of poisoning will ever be attempted with copper, whose decidedly nauseous taste and emetic property render it a very inapt instrument of crime. When it is taken accidentally, ammonia will always discover it, if in a quantity to do harm. As to the preparations of chrome, they are so very unlikely to occasion mischief, either by accident or design, that they may be considered as quite out of the question; and Dr. Porter's cautions are superfluous, in this point of view.

The use of chromate of potash, as a test of arsenic, I first ascertained and published in the summer of 1818, among the additions I made to Accum's Chemical Amusements. In September of the same year, I read a Memoir on the subject before the American Philosophical Society, and exhibited the experiment to the members then present. I was permitted to publish the substance of that Memoir, before it appeared in their Transactions. I did so in my Treatise on Medical Jurisprudence, published in 1819. I applied it, among other tests, with the most perfect success, last winter, to the contents of the stomach of a man suspected of being poisoned by arsenic, before my class here, and Dr. Davis and his students.

The summary of Dr. Porter's experiments, contained in your last Number, gave me the first intimation that that gentleman had been pursuing similar researches. I shall however rejoice if, among us, some useful truths are elicited on a subject of great interest. As you have not probably seen the publications to which I allude, I shall state a summary of the experiments, that will enable your readers to detect arsenic by means of chrome.

Take five watch-glasses, or the bottoms of as many wine-glasses or tumblers. Put on one, two or three drops of a

solution of white arsenic; on the second, as much arseniate of potash; on the third, one-fourth of a grain of white arsenic in substance; on the fourth, two or three drops of a solution of sublimate, either aqueous or alcoholic; on the fifth, two or three drops of a solution of copper; add to each three or four drops of chromate of potash, of the manufacturer's usual strength. In half an hour, a bright, clear, grass-green colour will appear in Nos. 1, 2, 3, unchangeable by ammonia. No. 4 will instantly exhibit an orange precipitate; No. 5 a green, which a drop of ammonia will instantly convert to a blue. The acid of chrome is converted into the green oxide, by the arsenious acid, which is now the arsenic acid.

I am, Dear Sir, your friend and servant,

THOMAS COOPER.

DR. PORTER'S REPLY TO DR. COOPER'S REMARKS.

New-Haven, Sept. 4, 1821.

IT may be premised that my experiments and remarks were not made with any view to publication, or they would have been more extended; but having come under the observation of Professor Silliman, he thought proper to make that reference to them which has given rise to Dr. Cooper's Letter.

Although I had the pleasure and advantage of attending parts of two of the courses of Dr. Cooper's very able Lectures, I have never seen him apply the test of arsenic, &c. For although I attended whenever my own duties gave me opportunity, it has so happened, that the Doctor never spoke of arsenic, or of tests for mineral poisons, while I was present. A sufficient reason for the fact, that Dr. Cooper's "own test" for arsenic was not noticed in my experiments, is assigned, when it is said it had not then come to my knowledge. My object, when I wrote, was, to call the attention of those gentlemen who were addressed, to the inadequacy of the directions laid down in the *common*

books in the hands of men no more acquainted with the subject than most of our *physicians*, to authorize an opinion on which life or death should hang, without the actual exhibition of the poison in the metallic state. I believe, that in many cases of sudden and apparently violent death, poisoning by arsenic would be immediately suspected; and if by the application of any tests, by the rules laid down in the books, results, such as were obtained by myself with the chromate of potash, should be observed, without further investigation it would be unhesitatingly said, "This person was destroyed by arsenic." It seemed, also, if the chromate of potash produced effects, in these trials, in *appearance* so much like arsenic, the other things, either simply or combined, *might* do the same; so that caution in deciding was by all means to be *recommended*. As to Dr. Cooper's objections to what he has denominated the first class of my experiments, he has gone on an erroneous supposition; for I not only agreed in his sentiment, that "no *chemist* could be led away by the ambiguity of colour, &c." but *my* very words were, there seems *no possibility* of mistaking the one for the other. "To the second assertion (Dr. Cooper proceeds) I object, that the statement in your summary is not quite accurate, as a matter of fact." To this I reply, that all *my* statements were believed to be perfectly accurate—there could be no object to induce an erroneous statement: and although I have not compared them with the "summary," I presume they will not be found to differ. This, Professor Silliman, under whose inspection the results of my experiments were all noted, and their accuracy assented to, will easily decide.

Dr. Cooper next observes:—"To the third statement of Dr. Porter, I object that it is not conformable to my experience." On this it need only be said, the statement is nevertheless correct, unless Professor Silliman and myself were greatly deceived; and that the experiments were scrupulously performed in the manner directed by Dr. Marcet, unless there exists some ambiguity in the instructions

(which are not now before me) that led me astray. It will readily be seen that my paper had no reference to poisoning by the preparations of chrome, of whose action on the system I am ignorant. My real design has already been stated.

As to the case of the man suspected of being poisoned by arsenic, last winter, I was not present when the experiment was made; nor did the affair come to my knowledge till some time after, when I was informed (how correctly I know not) that a man had poisoned himself, and that arsenic was found in him after death. Then, from the length of time which had elapsed since my experiments, and my engagement in other employments, they had entirely passed from my remembrance; as it was not my expectation they would be made known to any persons beyond the circle to which they were first addressed; and, of course, it is not to be wondered at that they were not mentioned to Dr. Cooper.

TIMOTHY DWIGHT PORTER.

VIII.—*On Browning Gun-Barrels.*

HAVING described, in our Article on "Iron and Steel," in our last Number, various improved modes of making twisted gun-barrels, it becomes incumbent upon us to describe the manner of bringing forth the beautiful veinings, so produced on their surfaces, to the utmost advantage; which is effected by the process of browning them.

The object to be accomplished, is, to fix upon the surface to be browned the compound oxides of iron and copper. A great variety of different receipts for effecting this are employed by the gun-makers, each believing his own to be the best. We shall indicate the essentials necessary to the success of the operation; leaving it to the judgment and experience of the individuals employing them, to produce the desired effect.

In the first place, the barrel, after being finished, and

well smoothed, by filing, &c., is to be entirely freed from all greasiness: this is effected by wiping it over with a mixture of powdered quick-lime and water, letting it dry, brushing it off, and again treating it in the same manner, until it becomes quite clean. Wooden plugs are then to be fitted into each end of the barrel, to serve as handles to hold it by, as well as to prevent any of the browning liquids from getting into and rusting the inside of the barrel.

In the next place, a solution of sulphate of copper (blue vitriol) is to be made in water; and some of it, by the aid of a little tow dipped into it, is to be wiped uniformly over the surface of the barrel: it must then be suffered to remain until the effect of the sulphate becomes visible, in various yellow and greenish stains being produced all over the barrel; which will indicate the forms of the twists made by the manner of working the mixture of hard and soft iron, of which it is composed. The roughness produced upon its surface by the action of the sulphate must from time to time be rubbed off with a hard brush, and a little water be wiped over it; when it must again be suffered to remain, to bring out the veining more distinctly: and this process must be repeated, until it is thought to be ready for *browning*. Should the oxiding action, however, have been too violent, or too long continued, without brushing, and the rust formed be too hard to be removed by brushing it, it will be necessary to have recourse to an iron-wire scratch-brush, with which it must be cleaned off. It may also be necessary to renew the coat of sulphate of copper, should the solution have been made too weak.

OF THE BROWNING COMPOSITION.

It is in this that so much difference prevails amongst gun-makers: and, indeed, unless the chemical preparations, of which it is formed, were to be always met with, in the shops, of the same degree of strength, it would be but of little use to give exact proportions. The following,

however, will serve to afford an idea of the nature of the mixture; viz.

Sulphate of copper, two avoirdupois ounces;

Chlorate of mercury (corrosive sublimate), sixty troy grains;

Dulcified spirit of nitre (impure nitric ether), one and a half liquid ounces;

Tincture of steel, one liquid ounce.

The sulphate of copper is to be dissolved in four wine quarts of water; and the chlorate of mercury to be rubbed up in the dulcified spirit of nitre and tincture of steel, and be then added to it.

Some gun-makers omit the chlorate of mercury entirely; which, indeed, is a late addition to the composition, although its action upon the iron of the barrel is very considerable.

This, or a composition of a similar nature, is to be wiped uniformly over the surface of the barrel, by means of tow, and be frequently renewed; employing the brush or scratch-brush occasionally, as required, until the browning effect is produced, and the barrel is become beautifully veined in light and dark-brown or black strokes or spots, and yet the barrel remain smooth or free from rust.

The action of the *browning* composition must next be stopped, by pouring boiling water, in considerable quantity, over the surface of the barrel: it may then be secured, by wiping it over, whilst hot, with bees'-wax, and rubbing it well into the browned surface; or, which is better, applying shell-lac spirit-varnish to it, in a similar manner.

It is to be observed, that very much of the success in browning gun-barrels depends upon the moisture or dryness and also the temperature of the weather when the process is performed. Moist weather, neither too hot nor too cold, is best for the operation. As it is necessary, however, to perform it in all seasons, very great judgment and skill, the results of long experience, are required, to succeed properly.

IX.—*Observations on the Advantages of Carburetted Hydrogen in Aërostation. By Mr.* CHARLES GREEN.—*In a Letter to the* EDITOR.

SIR, 49, *Goswell-Street, June* 16, 1822.

HAVING formed the idea that carburetted hydrogen was of sufficient levity for the purpose of aerostation; and seeing the advantages it would have over the hydrogen obtained from the decomposition of water; I convinced myself of the fact, by the inflation of a spherical balloon, 36 inches in diameter (the contents of which was 14 cubic feet), with carburetted hydrogen; the ascending power of which was ten ounces. This experiment was made by me at the Gas Establishment, Peter-street, Westminster, in the presence of the Governor and Committee of the Original Chartered Gas Company; to whose kindness and patronage I am greatly indebted.

I intended to have subjoined to the following Observations on the advantages to be derived from the employment of this gas, a short narrative of several interesting experiments made by myself; but being at present exceedingly busy in finishing a balloon, and fearing I should be too late for insertion in your valuable work this month, I have abandoned that idea for the present.

The balloon which I am now constructing will far exceed that with which I ascended from the Green Park, on the day of his Majesty's Coronation, both in beauty and dimensions. It is 106 feet in circumference; its superficial surface is 3318 feet; and its cubic capacity, 1752 feet. It is composed of varnished silk, of the three primitive colours, red, blue, and yellow, in alternate stripes, which have a most pleasing effect, from the formation of the compound colours, and their great variety of shades.

I remain, Sir, yours, &c. CHARLES GREEN.

Observations.

1. By the improved purification of the carburetted hydrogen gas before it enters the gasometer, it is de-

prived of all acid or acid vapour; and, consequently, the use of it is not injurious to the silk.

2. It is so much condensed by the cold in passing through the pipes under ground, that it enters the balloon at a lower temperature than the atmosphere which surrounds it; and therefore its bulk and levity are continually increasing. On the contrary, hydrogen gas produced by the decomposition of water, owing to the limited dimensions of the condensing vessels and other apparatus, enters the balloon at a much higher temperature than the atmosphere; and, in consequence, its bulk and levity are progressively decreasing.

3. A very considerable quantity of vapour, and frequently a portion of acid also, which is condensed, and deposited in the balloon, adds materially to its weight, dissolves the varnish, destroys the colours, and injures the silk.

4. It is not so penetrating as pure hydrogen.

5. The expense and incumbrance of an extensive apparatus are obviated; as is likewise the possibility of danger arising from the bursting of the vessels, &c. which has frequently occurred in the ordinary manner of filling balloons; as also the liability of mischief happening to the garments of those near the apparatus, from the action of the acid usually employed. All injury to the fertility of the soil, arising from the spilling of the acid or the sulphate of iron formed in the vessels, is likewise entirely obviated.

6. The carburetted hydrogen enters the balloon unmixed with atmospheric air. On the contrary, in the usual manner of filling balloons with pure hydrogen, as the capacity of the vessels employed for the production of that gas, to inflate a balloon of 32 feet in diameter, should be at least 500 cubic feet, to allow for the effervescence; and as the materials for generating the gas will not occupy more than 200 feet, previous to the decomposition taking place; it follows, that 300 cubic feet, or about 25lbs. of atmospheric air must likewise enter the balloon, unless a great waste is

made; as the hydrogen ascends, and the atmospheric air is not thrown over till the decomposition becomes rapid.

7. The inflation of a balloon with carburetted hydrogen can be effected in any given time, according to the pressure applied.

8. Another advantage is, that the operation of filling a balloon is not attended with any disagreeable smell, owing to the perfect closure and stability of the gas-pipes.

9. On account of the comparatively small expense attending the inflation of a balloon with carburetted hydrogen, various aërial and philosophical experiments may now be made; which, owing to the great expense hitherto incurred in filling balloons in the ordinary manner, have yet been very limited: it being proved, that six ascents with carburetted hydrogen can be made for the same sum as would be required for one only with pure hydrogen.

10. Carburetted hydrogen, towards the end of each charge of the retorts in making it, approximates in levity to pure hydrogen; no doubt from its holding less carbon in solution, as it then burns with a yellowish lambent flame. This gas, in large establishments, might be reserved in a separate gasometer; and would be exceedingly valuable to the aëronaut, although it is of but little value for the purpose of illumination.

X.—*On a peculiar Manufacture of the Pyroligneous Acid, and its Uses. By the late Mr.* CHRISTOPHER WILSON.

MR. WILSON was concerned, several years since, in a manufactory situated in the eastern part of the metropolis; where oaken chips from the Dock-yards were inclosed in a fire-stone oven, with apertures in the door to admit a very small access of air, only just sufficient to promote a slow combustion of the wood; *all contact with iron being carefully avoided.* The products of this slow combustion, or rather distillation, were condensed, and conveyed into

casks, and chalk added to them: this caused the tar to separate from the pyroligneous acid, and, rising to the top, to float off by a channel provided on purpose. This tar, on being boiled, formed an excellent pitch, fully equal to the best Swedish; and, like it, was perfectly well adapted to the uses of the Navy. The acetate of lime, in combination with the tannin and gallic aid, were employed in the preparation of a very superior kind of leather for gloves, which were much in request at that time.

It is much to be regretted, that the death of Mr. Wilson has prevented our obtaining any further particulars of this interesting process: but possibly some of the other parties concerned in the manufacture may feel disposed to communicate further particulars respecting it; which, in our present state of information on the pyroligneous acid, would indeed be very desirable.

XI.—*On the Manufacture and Uses of the Sulphurous Acid, in France.**

THIS acid, the knowledge of which may be traced to the most remote period, and first described by Stahl, was examined by Priestley, and analysed, a few years since, by Gay Lussac and Berzelius. It is rarely met with in nature, and that momentarily, by the combustion of sulphur or of sulphureous pyrites in the environs of volcanoes.

ON MAKING IT.—If to be used in the state of gas, it may be obtained directly in that form, by the combustion of sulphur supported by atmospheric air. By means of an exhausting and forcing pump, or of a double gasometer suspended at each end of a moving beam, a current may be produced which will direct the quantity of air upon the sulphur necessary for its complete ignition; we afterwards cause the products of this combustion to pass through water, solutions, &c. and it will thus be condensed. This process is much more economical than that which is now in use for

* From the *Dictionnaire Technologique.*

obtaining it in a similar state. It is true, however, that as these combinations have not yet been employed in very large quantities, the saving which might be made from any peculiar method of preparation will not be of great importance.

Sulphuric acid is obtained in the large way by the intermediation of the sulphurous acid: one kilogram of sulphur, on its combustion, furnishes 693 litres of sulphurous acid gas; or, in weight, one kilogram 930 grammes; which may be condensed in nineteen kilograms of water.

Sulphurous acid, which is intended to be combined with water or any other agent, is generally made by decomposing the sulphuric acid by means of heat; using powdered charcoal or saw-dust. Saw-dust or wood chips* are preferable, because their elements, carbon and hydrogen, are successively presented to the action of the sulphuric acid in a state of more complete division, and offer to it a far greater surface of carbon than charcoal; which last, from the aggregation of its molecules, is less easily acted upon. Into a glass balloon, placed on a sand-bath, we introduce one part of saw-dust; on which we pour three parts of concentrated sulphuric acid, by means of a tube bent in the form of the letter S, or a safety-tube. This mixture should not occupy more than two-thirds of the whole capacity of the balloon: then, by means of a bent tube, a communication is made with a Woulfe's apparatus; the bottles of which are two-thirds filled with the liquid in which the sulphurous acid gas is to be condensed: the mixture of sulphuric acid and saw-dust is then heated to a slight ebullition, and kept at this degree of temperature during the whole time of the operation. Thus, the liquid sulphurous acid, and the sulphites of soda and lime, may all be produced at one time: or one of them only. Liquid sulphurous acid is obtained in the bottle containing pure water; the latter absorbing thirty-seven times its own

* It is better to use chips, as they have not the inconvenience of adhering together, and forming a hard mass, which often happens with saw-dust.

volume, or nearly a tenth part of its weight, which is requisite to saturate it: the complete degree of saturation is effected when the sulphurous acid escapes from the bottle, and which is readily known by its smell. One hundred parts of sulphuric acid give fifty-four of the sulphurous acid, which are contained in the 540 parts of liquid acid obtained*.

The sulphite of soda is formed in the bottle into which had been put 200 parts of a solution of sub-carbonate of soda —40 of soda being equivalent to 100 of the sulphuric acid employed†. Also, the sulphite of lime will be found in the bottle wherein lime, in a mixture more or less thick, had been put; and which will produce, for 100 of the sulphuric acid, 115 of sulphite of lime: this will not dissolve entirely in less than 800 times its weight of water. Almost all the other sulphites are obtained in the same manner; but as they are only employed in the laboratories, we shall not notice them here. The sulphurous acid and the sulphites are prepared in a pure state for the use of the laboratory, by the re-action, upon one part of mercury, of seven of concentrated sulphuric acid, in a glass balloon, communicating with a Woulfe's apparatus.

Sulphite of lime may also be obtained in a solid form, in larger quantities, and more easily than by the method above described: instead of Woulfe's apparatus, we place at the end of the balloon into which the sulphuric acid and saw-dust had been put, a wooden barrel well hooped with iron, with a double bottom: the sulphurous acid gas is conducted by a tube to the lower part of this barrel, between the two bottoms; and there it finds no other way of escape but by holes perforated in the upper bottom. It then passes through chalk (carbonate of lime), moistened and broken

* These proportions are the *maximum* of products; which, however, may vary a little, by the losses which may happen in the course of the operation.

† If the solution of sulphite of soda is required to be more concentrated, the crystallized subcarbonate of soda is to be put into the water which has been already saturated. The sulphite of soda being much more soluble than the sub-carbonate, the crystals will quickly disappear, on their being decomposed by the sulphurous acid.

into lumps, with which the whole of the barrel above the upper bottom is filled. This chalk must be introduced lightly, and in small pieces, in order to leave interstices between the pieces for the passage of the gas. The large surface which is thus presented to its action not allowing the sulphurous acid to escape, it is condensed entirely: the heat, which is produced in the course of the decomposition of the chalk, vaporizes all the water with which it was moistened, and the sulphite of lime thus obtained is dry and hard. The relative proportions of the lime (100 of chalk being equal to nearly 50 of lime), the sulphuric acid, saw-dust, &c. are the same as are indicated in the first process.

Its uses.—The sulphurous acid, in the state of gas, is employed for bleaching wool, silk, and isinglass; to take out the stains of fruits; to remove bilious disorders, and cutaneous diseases; to clarify and stop the working of wines, &c. &c. We have successfully applied the acid sulphite of soda to the bleaching of the wood of the linden and other trees, used for basket-making, and for the hats called *white straw*. The acid sulphite of lime has been much used to stop fermentation in the must of raisins, from which it is intended to extract sugar or make sirup. Some manufacturers of sugar from the beet-root have lately used it for preventing the juice of that root from fermenting. It is also employed in stopping the vinous fermentation, and preventing the acidity in the making of spirits: a 500th part, in weight, of the fermented liquor is generally sufficient for this use. The action of the sulphurous acid and the sulphites is explained, by their property of liberating oxygen, and passing to the state of sulphuric acid and sulphates.

Theory.—The making of sulphurous acid, by combustion, is effected by the combination of sulphur with the oxygen of the atmosphere, in the proportion of 93 of oxygen to 100 of sulphur. If the sulphurous acid is extracted from the sulphuric acid, the latter is of course decomposed; one-third of its oxygen uniting itself with the

carbon: the result is carbonic acid, in the state of gas; the oxygen which remains constituting the sulphurous acid. If saw-dust or wood chips have been employed, the combination of the same quantity of oxygen of sulphuric acid with carbon and hydrogen, forms water and carbonic acid; the hydrogen disengaging itself to a free state; and the carbonic acid, which, on its becoming volatile, is combined with the water, the soda, or the lime, is freed from these combinations by the sulphurous acid.

DISTINGUISHING CHARACTERS.—The pure sulphurous acid is a permanent invisible gas: it greatly provokes to coughing: its odour is well known, as the smell of burning matches. The sulphites are equally well characterized; they destroy the blue colour of vegetables; and it is from this property that the dried sub-carbonate of soda, in commerce, is known to have retained its salts: indeed, by the saturation of soda in excess, the sulphites, or the sulphurous acid, entirely take out the blue colours extracted from mallows, violets, or litmus. The liquid sulphurous acid is white; of a very strong smell, like its gas; and should be preserved in bottles, well corked; as must be also the sulphites, to preserve them from the action of the oxygen of the atmosphere. The sulphites of lime and soda are white; the first being somewhat soluble, the other very much so: and both, like all the sulphites, are known by the smell of sulphurous acid gas, disengaged in their decomposition by the action of the sulphuric, nitric, or hydrochloric, &c. acids.

XII.—*On the Manufacture of the Sulphuric Acid, in France, and its Uses* *.

THE Sulphuric Acid has been prepared in France for forty years, but in a very imperfect manner. The more general method consisted in introducing into a chamber lined with lead, in size from five to ten thousand cubic feet

* From the *Dictionnaire Technologique*.

(from 121 to 243 metres), an iron carriage, sustaining a cast-iron receptacle full of burning sulphur; the combustion of which was aided by a mixture of 12, 15, and even 20 per cent. of nitre. When it was supposed that the combustion had ended, and the acid formed was sufficiently condensed in some inches of water with which the bottom of the chamber was covered—for during the operation, workmen were employed to throw in water, through a rose affixed to a forcing-pump—the door was opened by which the iron carriage had been introduced; and the carriage was drawn out, to empty its remaining contents, which were formerly thrown aside, although still containing 25 to 30 per cent. of unconsumed sulphur and sulphate of potash, but were afterwards partially brought into use in the manufacture of alum. The receptacle was then again filled with sulphur and nitre, and the operation re-commenced. The acid obtained in the chamber, and evaporated in leaden basons until it marked 50° of the areometer of Beaumé, was concentrated in glass retorts, 20 or 40 ranged in double lines, on the same sand-bath, heated by a single fire-place, the whole length of the furnaces: and this concentration was continued until it was impossible to drive off more of the water from the acid; which was then obtained, as at present, at 66° of Beaumé, equivalent to 1,845 degrees of specific gravity, water being 1000. This method, though somewhat varied by different chemists, generally furnished from 150 to 200 of sulphuric acid, at 66° for 100 of the sulphur consumed; and yet it often happened that these operations, in the large way, entirely failed.

After this, the use of the carriage was suppressed, and a fixed furnace was constructed under the chamber: the concave plate, on which the sulphur was spread, was heated by a furnace underneath it; and the combustion of the mixture of 100 parts of sulphur with from 10 to 12 of nitre could be regulated, and was constantly kept up, by a little door, which was occasionally opened for

this purpose: a hole, two inches above the level of the sulphur, gave a constant access to the external air; and a chimney, raised at the other end of the chamber, produced a current, which frequently drew off the uncondensed acid gases. These gases, especially in damp weather, fall at a great distance from the building, and destroy the surrounding vegetation. There remains in the chamber several inches in depth of the acid; and, according to the size of the building, a proportionate quantity is drawn off daily, corresponding to that made, which is concentrated in the range of retorts already described. This process, to which some useful modifications have since been added (the most important being the substitution of a single boiler of platina for 20 or 40 glass retorts), is still that most generally employed; and hereby is obtained, for 100 parts of sulphur, from 250 to 260 of acid, at 1,845 degrees of specific gravity, or 66° of Beaumé.

The process which we are now about to describe is only in the hands of a few chemists. I explained the results to Mons. Thenard, in 1819; and a workman, whom I employed at that time, confirmed them. It affords, on the large scale, and constantly, if attended with care, 300 parts of sulphuric acid, at 66° of Beaumé, or 1,845 specific gravity, for 100 of sulphur. According to the definite proportions, the proper quantities are—

Sulphur	100
Oxygen	150
Water	62 50
	312 50

It is scarcely possible to calculate nearer, in the operations of a manufactory.

Description of the Apparatus.—For a chamber A (see Pl. I. fig. 1.), of the contents of 20,000 cubic feet, the most favourable dimensions are, 50 feet in length, 27 in breadth, and 15 feet in height. The process may, indeed, be con-

ducted in a room of different dimensions; but, from observations made with care, it has been found that the proportions should be nearly similar to the above, to ensure the certainty of success.—A leaden cylinder, B, eight feet in diameter, and six feet high, rising ten inches above the floor CC, is placed at one end of the chamber. The lower border of this cylinder, DD, is bent inwardly, so as to form a circular channel or trench, EE, concentric with the cylinder, in which a constant supply of weak acid, GG, may be kept, to prevent the lead cylinder from becoming too hot, and yet so as to let it be warmed by the heat which is continually produced. The whole is supported by the brick-work H; in the middle of which rests a circular cast-iron plate, K, three feet four inches in diameter, one inch thick, made a little concave, and its edge placed three inches above the fire-place L, L, which is intended to heat the whole surface of its bottom. Level with the edge of this plate, a door, M, is made in the leaden cylinder, two feet in height by 18 inches in width, with a hole, N, in its lower part, one inch in diameter. At the other end of the chamber are placed two water-valves, P, 18 inches in diameter; which are surmounted by two wooden chimneys, Q, sufficiently elevated to cause a very strong current: these ought to be at least 15 feet high.

All being thus prepared, and the door and the chimneys closed, a fire is kindled under the plate; and when it has become so hot that a pinch of sulphur thrown on it instantly takes fire, it is charged with sulphur; 50 kilograms* being necessary for each operation. And at the same time, a glass matrass, R, placed in a sand-heat, and containing four kilograms 300 grammes of nitric acid, and 500 grammes† of melasses, mixed together, is heated; and the nitrous gas which disengages itself is conducted

* A kilogram is 2 lbs. 3 oz. 5 dr. avoirdupois weight.

† Five hundred grammes is half a kilogram.

by a tube into the lower part of the leaden cylinder, two feet above the burning sulphur. This operation is continued until all the nitrous gas is obtained from the mixture above described. *Oxalic Acid* is extracted from the residue.

About two hours after the combustion of the sulphur has commenced, the cock of a steam-boiler, S, is opened, the tube of which is introduced into the middle of the chamber: this tube, T, is an inch in diameter, but its orifice, U, in the chamber, is reduced to six lines only (13 millimetres), with a view to cause the steam to escape with force. This injection must continue till all the steam necessary for the absorption of the acid shall have been introduced. The quantity requisite for the operation is 50 kilograms; and the surface of the boiler, heated to produce these results, is five feet square.

Some minutes after the introduction of the steam into the chamber has commenced, a condensation is perceived in the interior: the little hole, N, in the door of the cylinder, must then be unstopped, to give free access to the atmospheric air. When the steam is injected (the combustion of the sulphur and the disengagement of the nitrous gas occupying less than two hours) the condensation of the vapour commences, all being closed: and when this is ended, the door of the cylinder, and the two chimneys, are opened, for the purpose of renovating the air in the interior of the chamber as thoroughly as possible, preparatory to commencing another operation.

These operations may be repeated four times in the twenty-four hours: but it is very difficult to pursue this course; it is much more easy to make three, which produce better results: it is even preferable to make but two; as less care is required, and there is less liability to accident; the condensation is more perfect; and the lead of the chamber, being less frequently exposed to expansion and contraction, is not so much injured.

The whole bottom of the chamber should constantly be

covered with a layer of liquid. As the bottom has an inclination of 18 centimetres, this layer, VV, will be found to be, at one extremity, 22 centimetres in depth, and only four at the other: we should never, therefore, on any day, draw off a quantity sufficient to sink it below that level. The acid thus daily drawn off should mark about 40° of Beaumé: it may be raised higher; and some chemists do so, with the design of economising the fuel required in the concentration; but they obtain a smaller quantity of acid; and, if they have raised it in the chamber to 50° or more, it absorbs, at this specific gravity, a portion of nitrous acid gas, which it is impossible to free it from by concentration. The avoiding these inconveniences fully compensates for the expense in evaporation, which they wish to save.

One test of the purity of sulphuric acid, which is adopted in commerce, and which fully demonstrates its purity, is its property of dissolving indigo without altering its fine blue colour. The sulphuric acid obtained by the process which we have described, contains scarcely any sulphate of lime; because almost all the water required is furnished by steam, and is consequently distilled water.

If it should be requisite to remove all the acid from the bottom of the chamber, to repair it, or for any other purpose, before recommencing the operation, all the bottom must be covered with weak acid, from 10° to 12° of Beaumé: but if water only be used, or if none at all be employed, there is a great hazard of obtaining very little, if any products:—the same as if this operation had been begun in very dry, cold weather, without having heated the interior of the chamber by an injection of steam. Manufacturers having neglected this precaution, have entirely lost the fruits of their labours; which, without this error, would have produced the best results. It is absolutely necessary to bear in mind, that water and heat are essential requisites in the formation of sulphuric acid. A singular circumstance has often occurred in those laboratories where they work according to the method called

à courant continu. In dry weather, and more particularly during frost, it has been observed, that the chambers, into which the products of the combustion of sulphur and saltpetre have been conveyed, as usual, have not condensed the smallest quantity of acid:—this accident has been called, at Marseilles, *maladie des chambres.* They could find no other remedy, than by stopping the work for some time; and on recommencing it, the same evil would not occur.—The best means of preventing this mischief, when likely to take place, is, to eject a sufficient quantity of steam into the chamber, so as to wet and heat the whole of the interior.

The concentration of sulphuric acid commences in leaden caldrons, whose surface is so considerable, that the acid contained in them shall only be 30 centimetres deep: the acid is concentrated, by evaporation in these caldrons, till it marks 50° of Beaumé: it is then drawn off into a vessel of platina; which, being made in the form of a common matrass, should contain, in two-thirds of its height, about a fourth part of the daily product of the manufactory; where four operations are generally made each day: but when every thing is arranged perfectly convenient, it is easy to make six. The head of the matrass is also of platina; and conducts the vapour into a leaden worm, where it is condensed. A sufficient quantity of acid is drawn off during the distillation to make it worth while to condense the vapours.*

When the acid has arrived at its point of concentration, it is drawn off from the distilling vessel, through a platina syphon fitted to it; the exterior of the branch of the syphon belonging to the boiler is covered the whole of its

* At the temperature to which sulphuric acid is raised during its concentration, the lead will unite itself to the platina, and render it fusible: it has happened in some laboratories, that small particles of lead have fallen into the platina vessels, and made holes in them of many millimetres in size. The use of lead, therefore, should be carefully avoided, and all accidental holes or cracks may be repaired by soldering on small pieces of platina, gold being generally used as the solder.

length (about two metres) with a double copper tube, through which a current of cold water passes; so that the acid, on reaching the extremity of the siphon, may be sufficiently cooled, to prevent its breaking the stone-receivers; from whence it is drawn into large stone-bottles, packed with straw, in baskets with handles; the bottles being closed with earthen stoppers, covered with clay, and then wrapped up with coarse linen, and corded: and in this state they are sent to market.

There are two methods of constructing the leaden chambers: we will describe both; because experience has not sufficiently demonstrated the choice we ought to make between them. That longest known in France consists in uniting the sheets of lead which form the bottom of the chamber, and bending the edges of each so as to form at their joints a conical gutter, five centimetres wide, and five deep; all the interior surface of this gutter being well scraped, and filled with a solder composed of two parts of lead and one of tin. The sheets of lead forming the sides of the chamber are joined by similar gutters, incased in wood-work; the upper part, or ceiling of the chamber, is formed of bent sheets of lead, 16 or 18 centimetres wide; secured on the outside of the chamber between two pieces of wood, the length of which is equal to the size of the chamber: the two sheets of lead are beaten close to these pieces of wood, leaving between them a conical gutter, to be filled with solder composed as before described.—This construction affords much solidity, and is easily effected: but another has lately been substituted, for the purpose of economising the workmanship and solder; and differing from the former in the manner of joining the sheets of lead together, which is done in the following method, by means of what is called the *English solder*. The sheets of lead being well scraped along their edges, the width of four centimetres, they lay the two parts, well fitted, upon one another horizontally; and run between them a little pure melted tin; the greater part of which they then force out,

by a strong pressure: the sheets, thus joined, are held laterally at the upper part of the chamber by loops of lead, which surround a piece of wood, and are soldered, at each end, to the sheets of lead. This manner of construction is economical and firm, but difficult to execute; for if, for example, we should not succeed in expressing the greatest portion of the tin which is run between the edges of the sheets of lead, the sulphuric acid soon dissolves it, and makes itself a passage.

Whatever method may be followed in the construction of the chambers, it is important that they should be isolated, on all sides, from the building in which they are inclosed; in order to perceive and easily repair those places which are leaky, whether owing to defects in their construction, from use, from imperceptible defects in the leaden sheets, or from any other cause.

Characters.—The Sulphuric Acid, such as is sold in commerce, and generally employed in the Arts, is white, without smell, of a siropy consistence, of the specific gravity of 1845°, water being 1000°, is volatilized at a high temperature; its vapour is white, acrid, and powerfully acts upon the animal economy. Its presence is known by the solution of barytes, and of a soluble salt of barytes in nitric acid, with which it forms an insoluble precipitate. The sulphuric acid serves as a means of ascertaining the saturating power of the Alkalies of Commerce, and their relative value; and, reciprocally, an alkali may be employed to shew the quantity of real acid contained in sulphuric acid of different degrees and strength. If, for example, it is essayed with crystalized sub-carbonate of soda, equivalent to 28 centiemes of pure sulphuric acid, or $\frac{35}{100}$ of sulphuric acid of 66°, it is evident that 100 of sub-carbonate of soda is equivalent to 28 of real sulphuric acid, or 35 to 60; the whole quantity of sub-carbonate of soda employed in the essay indicating the proportionate correspondent quantity of pure sulphuric acid, or sulphuric acid at 66°.

Uses.—The Sulphuric Acid is, of all the acids, that which is most employed; and, in effect, it is used to obtain almost all the others, by disengaging them from their combinations; it is thus that they prepare, on the large scale, the nitric, hydrochloric, hydrosulphuric, tartaric, acetic, &c. acids: it is used in the manufacture of alum, of the sulphates of copper, zinc, potash, and soda; and in the manufacture of sulphuric ether; of alcohol, by the process of the saccharization of starch; of phosphorus, &c.: it is likewise used to raise the skin in tanning, to clean metals, and to ascertain the nature of many of the salts by the characters of the acids which it disengages.

Theory of the Formation of the Sulphuric Acid.—The theory now received has been advanced by Désomes and Clément.* These Chemists thought, that the nitrous acid gas mixed with the sulphurous acid gas would re-act upon each other by the aid of a little water; and that from that action would result a combination of sulphuric acid, and a deutoxide of azote and water, a combination which would be instantly disunited by the addition of a larger quantity of water, and from which the sulphuric acid would separate itself under a liquid form, leaving the deutoxide azotic gas disengaged; this would re-constitute nitrous acid gas from the oxygen of the atmosphere, and, again placed in the same circumstances as at first, would re-act anew in the same manner on the nitrous acid gas, give birth to the same combination, from which would result the same products; and that these alternate re-actions would continue, till the total destruction of the sulphurous acid gas, or the oxygen of the air.

To be assured that this really took place in the chambers, they mixed, in a transparent matrass, the three components—the deutoxide of azote, the sulphurous acid, and air. The appearance of red vapours presently indicated

* Some years since, M. Pluvinet had conceived and explained it in the same manner, in a Letter which he wrote to M. Chaptal, sen. on the properties of sulphur.

the transformation of the deutoxide of azote into nitrous acid gas; afterwards, by the aid of a little water, the re-action commenced, and white opake vapours were formed, and deposited in white starry crystals, on the inside of the matrass: the gas was then become diaphanous, and without colour; a new addition of water dissolved these crystals with effervescence, and the red vapours reappeared. These phenomena are thus alternated, until all the oxigen of the air is taken up, and the sulphurous acid is exhausted: and as the remaining gases are found to be nitrous acid, and azote without sulphurous acid, and that the unctuous sulphuric acid moistens all the interior of the matrass, it is concluded that the demonstration of the theory is here indicated.

A later experiment made by M. Gay-Lussac has thrown some doubts as to the manner in which the nitrous acid acts in this operation. If we make a vacuum in the matrass after the starry crystals have been deposited, and fill it with carbonic acid gas, the addition of some drops of water will cause the red nitrous acid gas to be disengaged with effervescence: then the nitrous acid enters into the composition of these crystals, which Désormes and Clément regarded as being formed of sulphuric acid and deutoxide of azote; whence they concluded that the deutoxide of azote probably might not have been an agent in this operation, and that the oxydation of the sulphurous acid was entirely effected by the intermediation of the nitrous acid. I do not think that they ought to draw this conclusion: in fact, when they had injected into the chamber all the nitrous acid gas, sulphurous, and a little steam of water, the formation and condensation of the sulphuric acid formed a vacuum, and the gas became colourless: on giving access to the atmospheric air, the acid appeared red:—the re-action commences: if again the communication with the external air is prevented, while the condensation of the sulphuric acid takes place, the gas contained in the chamber becomes again white and transparent;

but reddens afresh the instant on air being absorbed:—thus, each time the tranformation of the nitric acid gas into the deutoxide azotic gas takes place, the red vapours disappear; and each time also that the recomposition of the nitric acid gas is effected by the re-entrance of the air, it is shewn by a new appearance of the red gas. In this operation, therefore, the deutoxide azotic gas performs an important part.

But the nitrous acid forms a constituent part of the starry crystallizations (Gay-Lussac): the nitrous acid, on being poured into the concentrated sulphuric acid, combines with it, and instantaneously forms a crystallization; the nitrous acid is even again combined with the liquefied sulphuric acid. The nitrous acid has, therefore, a most decided action on the sulphuric acid, whether it has concurred integrally to its formation, or if it should not have been united till after the complete formation of the latter. It is always very important to know this combination, and the circumstances which favour or hinder it, for the purpose of perfectly understanding the disengagement of the nitrous acid.* Finally, it is easy to perceive the application of these several principles, in the precautions which are herein shewn, as the means of avoiding some difficulties in the course of manufacturing on the large scale. P.

REFERENCES TO PLATE I.

Fig. 1. A section of the leaden chamber, furnaces, &c. for the manufacture of sulphuric acid.

Fig. 2. A plan of the plate on which the sulphur, &c. is consumed. W, pipe to empty the channel E.

Fig. 3. A section, on a larger scale, of the wooden chimney Q, and the water-valve P, in fig. 1.

Fig. 4. A section of the rafters which unite the sheets of lead forming the ceiling of the chamber.

* A too great action of the water might carry the decomposition of the nitrous acid so far as to form the protoxide of azote.

XIII.—*On American Ice-Closets and Houses. By the* EDITOR.

THE inhabitants of the cities and large towns in the United States, make great use of ice. Most families are furnished with an *ice-closet*, in which they keep cool their milk, butter, cream, meat, &c. during the heat of their summers, and thereby greatly prevent the waste of provisions that usually occurs at that season. These ice-closets are constructed in the following manner: Two wooden casks are provided, a greater and a lesser one, of such sizes as to leave a space of about two inches between their bottoms and sides; this space is filled up with charcoal, in small lumps or grossly powdered, so as to leave interstices between its parts; a double cover is also provided, likewise filled with charcoal; so that when the cover is on, the inner cask is entirely surrounded with charcoal, which, as is well known, is an exceedingly slow conductor of heat and cold. The interior of the closet is furnished with shelves all around it, for the vessels, &c. to be placed upon; and a pipe passes through both casks, at their bottoms, to allow the water from the melted ice to drain off. The bottoms of these closets are covered with ice, with which the owners are supplied daily by persons who make it a business to carry it about in carts, and sell it at a moderate price; and who are themselves furnished by the proprietors of ice-houses, which are very common throughout the United States. These ice-houses are generally sunk a little way only beneath the surface of the earth, and are surrounded with double sides of wood, with a layer of straw interposed between them, and a door similarly constructed; they have, likewise, a roof of straw-thatch.

Professor SILLIMAN, however, recommends the roof to be covered with wood and painted white; and be thatched with straw beneath the wooden roof. "The surface of the roof thus becomes reflecting and non-absorbing; and the substance non-conducting, in relation to heat."—He adds, that he "can speak from experience of the efficacy of this arrangement*."

* *American Journal of Science and Arts*, Vol. IV. p. 177.

We should sincerely rejoice to witness the adoption of these important additions to our domestic comfort and economy, in this country. Had we been now provided with them, we should not have had to regret the great scarcity of ice among us, arising from the uncommon mildness of the last winter; as a sufficient quantity might, nevertheless, have been stored up, had the proper receptacles been at hand.

XIV.—*On Domestic Telegraphs.**

Mr. Pearson, of Boston, U. S. has obtained a Patent for a Domestic Telegraph, which consists of two similar circular dial-plates, with indexes and toothed-wheels communicating with each other by means of rods. The dials are placed upright, and are divided by circles into three divisions; the *inner* one of which contains the letters of the alphabet; the next *exterior* one, figures to the number of 30; and the *outer* one is divided into 30 compartments, each of which contains the name of an article in full. These divisions will generally be found to contain as many articles as usually comprehend the wants of a family. Should any articles, however, be wanted, not expressed by words on the dial, it may with ease be communicated by turning the index to the letters requisite to make out the name of the article.

By the power of the alphabet it will be readily seen that the Domestic Telegraph may be rendered the medium of communication to an indefinite extent. For the sake of convenience, by an understanding between the parties, words may be so abbreviated, that certain letters shall stand as their representatives. Thus the names of domestics may be designated by the initials, and the figures may likewise be applied to similar purposes.

By these arrangements, it not only appears how easily domestic wants may be supplied, and private communications held, by the use of the Domestic Telegraph, but that it may be made to facilitate the conveyance of intelligence

* Taken, with alterations, from *Silliman's American Journal of Science and Arts*, Vol. IV. No. 2.

through all kinds of buildings; such as stores, warehouses, counting-rooms, &c. &c.

The Domestic Telegraph has for its recommendations the following advantages, viz.

1. The ease, facility, and dispatch with which domestic wants may be supplied.

2. The great saving of labour to domestics, &c. rendering their attendance less irksome to themselves, and more acceptable to principals.

3. The privacy with which domestic communication may be held in the presence of company, and in many other cases that often occur.

4. In cold weather, obviating the necessity of so frequently opening the doors of apartments, which is so incommodious and disagreeable; besides admitting the influx of cold air.

5. By the indexes moving over the two dials, an almost instantaneous communication is effected; as they operate simultaneously, by means of the connecting rods and wheels.

The motion, giving the alarm to direct the domestic's attention to the face of the dial, is by means of an horizontal rod, having upon it a small pinion, connected with the toothed-wheels; on the rod two small bells are fixed, with their mouths, rims, or peripheries facing each other. A small space is left between the bells to give freedom to their vibration; to produce which, a cast-iron ball is inclosed between them, and revolves on the inner side of their extremities.

It should be observed, that the toothed-wheels spoken of should be *bevel-wheels* of equal diameters; one pair being used to each index; and others, according to the course or direction necessary to be given to the connecting-rods.

The simple structure of this Telegraph enables its inventor to furnish the common one at the low price of five dollars; while, from its form, it is peculiarly adapted to decorate the most elegant rooms. The inventor proposes placing the more costly ones on pedestals, vases, &c. &c. as chimney or table-ornaments.

Instead of the two bells above described a single fixed bell may be used, to be struck by four loose clappers, affixed to the arms of a wheel upon a rod, having also a bevel-pinion acting in one of the bevel-wheels.

Remarks by the EDITOR.

The use of Domestic Telegraphs is not new in this country: the late celebrated MERLIN exhibited one in his Mechanical Museum, which consisted of two similar japanned metal-plates, fixed upright against the walls of two rooms, situated one exactly above the other; and two indexes mounted upon a sliding wire passing through the floor of the upper room to the room below, pointed out the corresponding articles upon both plates. The Editor, many years since, likewise, saw another, made by the Rev. Mr. Hall, of Haslar Hospital, Gosport; which was yet more simple, being merely a list of the articles required painted upon the wainscot of the upper room, and having a brass-headed nail driven into the wainscot opposite to each article; a ring, having a line or cord affixed to it, was hung upon the nail opposite to the article wanted; and the line passing through the floor, indicated the same upon a corresponding list of articles below, by means of a weight hung to it.

A very simple modification of the circular telegraph might be accomplished by fixing the dials horizontally, the upper one with its face upwards, on a table or other convenient support; and the lower one with its face downwards against the cieling of the lower room, in case of communicating below; or the reverse, if the communication is to be made upwards. All that would then be wanting is, a straight inflexible rod or axis, carrying both the indexes, and of course, pointing out on the one dial the corresponding article upon the other. In case of telegraphing with rooms adjoining to each other, or situated in a direct line on the same floor, it is evident, that it is only necessary to place the dials vertically against the walls of the rooms to obtain the same results.

Of course, the ordinary house-bells will, on being rung, answer every purpose of calling the attention of the domestics, equally well as those proposed by Mr. Pearson.

XV. — *On Soldering Lead, by the Process termed Burning-to. By the* EDITOR.

THIS process is of great use in the construction and repair of the leaden boilers, used for the concentration, by evaporation, of the weak sulphuric acid from the chambers, and for making solutions of copper, &c. in the sulphuric acid, where the ordinary solder, containing tin, would be destroyed.

These leaden boilers, being placed immediately over the fire in the furnaces, are exceedingly liable to melt, whether in the case of the boiler becoming dry, or from the formation of crystals, which prevent the access of liquid to the lead. The mode of repairing them will afford sufficient information on the nature of this valuable process.

The melted part being cut out, and the hole made of a square, or other regular form, a piece of sheet-lead is shaped so as to fill it exactly: this piece is supported in its proper situation in the hole, upon a bed of moistened sand placed underneath it. A narrow channel is then made above, in moistened sand, all round the edges to be united; placing a bar of wood, one inch square, over one side of the gap, and moulding the sand close to it; when it may be shifted to another part, and so on, until a square channel is made all around. Melted lead is then to be poured into this channel, and the pouring must be continued until it is judged that the lead of the boiler, and the new piece to be soldered to it, are fused and united together. When all is cold, the wall of lead must be cut away even with the surface of the bottom of the boiler, and the operation is finished.

It is hardly necessary to add, that a considerable quantity of melted lead must be provided, to supply the place

of that which is continually flowing off over the sides of the channel during the operation.

In this way, leaden vessels, for containing the fluoric acid, &c. may have bottoms made to them; all that is necessary is, to cast the bodies of the vessels in properly formed moulds, and to place them with their mouths downwards in moistened sand: their interior must then be filled up with sand even with their rims; and a piece of wood, equal in thickness to the intended bottom, being then laid upon the rim, the sand must be moulded all around it: when the wood is removed, the sand will form a cavity to receive the melted lead, which must then be poured in, and be suffered to overflow, as above described, until the union is effected, by the fusion of the rim; the sand inside and outside of it, preventing its change of shape during the process.

XVI. *Improved Mode of Soldering Cast-Steel Articles. By the late* W. E. Sheffield, *Esq.*

Instead of employing the usual speltar-solder, or brass, for uniting the *highly-converted* cast-steel, and which, on account of the great heat requisite to fuse them, are very likely to injure the quality of the steel, Mr. Sheffield substituted *silver solder* with the most complete success, as it not only fused with a less degree of heat, but was also attended with this advantage, that the *white colour* of the solder was much less distinguishable upon the joints, than when the *yellow* speltar-solder was used.

Gold has been frequently used for soldering delicate articles made of cast-steel, and is certainly preferable to speltar-solder, in respect to its more readily fusing: still, however, it is objectionable, not only on account of its yellow or red colour, but also by reason of its high price. Silver-solder ought therefore to be preferred, where we wish to preserve the good qualities of cast-steel uninjured, and to make neat, and almost imperceptible joints.

THE FOLLOWING IS AN EXCELLENT SILVER SOLDER.

Melt together, under a coat of charcoal-dust, nineteen penny-weights of fine silver; copper, one pennyweight; and brass, ten pennyweights.

XVII. *On various Processes employed in Jewellery.* By the EDITOR.

THE jewellers are in the habit of performing many operations, in the formation of their delicate and beautiful works, in a manner which is highly deserving of adoption in other branches of manufacture. It is with this view that we have determined to lay before our Readers some of the more important of these processes; and, first,

ON SOLDERING IN JEWELLERY.

In soldering with Silver Solder, the thinly laminated solder is scraped perfectly clean, and then cut with hand-shears into very small square bits, by first dividing the sheet into narrow slips lengthwise, and then cutting them again across. The lump of borax, which is employed as a flux, is rubbed with water, to a thick consistence, upon a flat piece of black slate, scored all over crosswise, to cause it to act upon, or abrade the lump of borax the more readily. When the pieces to be joined are ready for soldering, with a small camels'-hair pencil, having a slender ivory handle, flattened at its point, they take up some of the prepared borax, and apply it, by means of the pencil, to the parts to be united; they next mix, upon the thumb-nail of the left hand, some of the small square bits or pellets of solder, taken up on the hair-pencil, with borax, so as to cover them perfectly therewith: these pellets are then carefully applied, by the help of the point of the ivory handle, to the parts to be soldered: and they are then laid upon charcoal-ashes, contained in a small crucible, and are submitted to the action of the flame of a lamp, urged by the blow-pipe; carefully, however, avoiding to heat them too suddenly, or before the borax has ceased bubbling, during the driving off its water of crystallization (which,

however, in this mode of employing it, is considerably less than in the ordinary practice), lest the pellets should be displaced. When the solder has flowed, they very carefully avoid heating the article more, lest it might melt.

In case they wish to prevent the solder from spreading over the surrounding parts, they previously coat them with a layer of Indian ink, applied upon another camels'-hair pencil.

In the soldering of Fillagree-work, the process is different. The gold or silver solders are previously reduced, by filing, to a state of minute division, and are then put into proper small cylindrical metal-boxes, with lids closely fitted to them, and having near their bottoms slender pipes, to allow a little only of the powdered solder to escape at a time, by the action of the finger-nail, rubbed upon a serrated piece of metal, affixed upon the pipe.

The articles to be soldered require to be treated according to their nature and forms. If, for instance, a number of similar twisted wire-rings are to be united in a flat circular form, they are to be laid upon a piece of charcoal, sawn and rubbed flat, and are arranged and kept in the required form, by the application of a thick solution of gum-tragacanth, brushed over them and the surface of the charcoal: they are then either laid by, to afford the gum time to dry leisurely; or, if haste prevents that, they must be exposed to a very gentle heat. When dry, the thick mixture of borax, before mentioned, must be brushed over them, and the solder be sprinkled upon them in the manner just described: they are then exposed to the action of the flame of the lamp, whilst lying upon the surface of the charcoal;—great care and address, however, being requisite in the management of this very delicate operation, as the least excess of heat would inevitably fuse the whole into a solid mass.

When such an arrangement has been thus formed, and other parts are to be soldered to it, a solder of a more fusible nature must be employed; and the parts are either

to be arranged upon charcoal, in the manner above described, or they may be held and supported upon the branched extremities of a congeries of jewellers' twisted fine iron binding-wire, formed as follows:—Several similar lengths of wire are first twisted together, three at a time, leaving a portion of each untwisted: these are again united together at one end, in three or more sets of three each, leaving their exterior ends at liberty; and, lastly, these combined sets all are united by twisting them together. The mass forms an exceedingly convenient support for the infinite variety of different articles of jewellery, which require to be soldered together; and their union is effected, as before described, by the application of the borax and solder, and exposure to the flame of the lamp.

[*To be continued.*]

XVIII. *On the Manufacture of Oxalic Acid, in France.* *

Most chemists attribute the discovery of the Oxalic Acid to Bergman; but others give the honour of it to Schéele. It appears that both these chemists have had a share in this discovery, and by methods totally different. Bergman, about the year 1776, found, on treating sugar with the nitric acid, that it was converted into a very strong vegetable acid, crystallizable, and to which he gave the name of the *saccharine acid.* Schéele shewed, in the year 1784, that a factitious acid was constantly formed in the salt of sorrel, which had been confounded with tartar, or its acid: he composed the salt of sorrel of every kind, by combining the saccharine acid with potash; from whence he called this acid, the discovery of which produced a great sensation, the *oxalic acid,* from the generic name of one of the plants which furnishes the salt of sorrel. For some years, they have used large quantities of the oxalic acid in calico printing, wherein it is employed without reserve; that is to say, as a means of destroying the mor-

* From the *Dictionnaire Technologique.*

dant on those parts where they wish the colour not to take, and thus preserve the cloth of its original whiteness. It is also used with advantage in various colours, and to take out iron-moulds.

This acid may be procured, either by making it artificially, according to the process of Bergman, or by separating it from its natural combinations. We shall give both methods: sugar is not the only vegetable product, which, treated by the nitric acid, affords the oxalic acid; there is an infinity of others: the amylaceous fecula furnish it also, and in great abundance. Gum affords a less quantity. Many animal substances, and particularly wool, silk, albumen, gelatine, &c. also yield a certain quantity; but sugar and fecula are the two materials which afford it with the greatest advantage.

[*To be continued.*]

XIX.—MISCELLANEOUS.

Wrought-Iron Steam-Boat.

The Aaron Manby, iron steam-boat, arrived at Paris, from London, on the 11th inst. with a cargo of clover seed and cast-iron. The voyage from London to Rouen was performed in 55 hours. She left the latter place on Thursday morning, and would have reached Paris on Saturday evening, if she had not taken the ground near St. Audley's, in consequence of a rope breaking, and being hindered from proceeding by the crowds which came on board at different places to view her. This voyage will be for ever memorable in the history of navigation, it being the first attempt to traverse the ocean in a vessel composed of any material but wood. The enterprise has proved decidedly successful.—Thus we have a direct communication open between the two great capitals of Europe, and which is performed in a shorter time than is taken by the stoutest merchantman to sail to Rouen only. Not the slightest accident occurred during the voyage, nor could the people on board

discover any difference in the movement of the vessel from that of the strongest vessel that navigates the seas.—(*Journal des Debats, June* 16, 1822.)

In addition to the particulars we have before given respecting this steam-boat, we are enabled to state, that each wheel has, in fact, eight paddles; the four, which the wheel was said to contain, being each divided into two, by which contrivance a more favourable shape is given to them for acting upon the water; the two forming between them, as it were, a sort of hollow scoop, which prevents the water from escaping sideways, as is the case with flat paddles.

It is this construction which has led to the employment of the forty-eight bevel-wheels mentioned in our last Number.

PREMIUMS

Offered by the "Society for the Encouragement of National Industry" in France, for 1821 *and* 1822.

MECHANIC ARTS.

I. For the construction of an Hydraulic Press, particularly adapted to the expression of olive and grain oil, and the compression of grapes and other fruits.—Two thousand Francs.

II. For the construction of a Water-mill, which shall not obstruct the current of rivers, nor impede navigation, floatage, or the irrigation of meadows.—One thousand Francs.

CHEMICAL ARTS.

III. For perfecting the materials employed in engraving *en taille-douce*. The conditions to be fulfilled are:—1. A procedure by which the copper-plates may be prepared of a density suitable to the wants of the art, and arising from the nature of the metal, and not from the violent pressure of the smoothing process. 2. To perfect the varnish, and the manner of applying it so as to prevent its scaling, as well as the accidents which frequently hap-

pen when the plates are corroded. 3. To shew the effects of various acids on copper-plates, both pure and mixed, and of different degrees of strength.—Fifteen hundred Francs.

IV. & V. *For the Fabrication of Russian Leather.*—There is reason to believe that the pyroligneous acid, derived from astringent bark, may be very advantageously used in this process. It appears evident, from the writings of Pallas and others, that *whey* and *tannin*, derived from the bark of the willow or the leaves of the *statice limonium*, and the oil of birch-bark and the smoke of the branches of that tree, are constantly employed in the process followed in Russia.

Two premiums, one of Three thousand, and the other of Fifteen hundred Francs, are offered for the two best specimens of the leather of cows, calves, sheep, or horses (one of each kind), prepared with pyroligneous acid, as it issues from the wood, or after the separation of its constituent parts.

VI. For the discovery of a Metal, or an Alloy of Metals, much less oxidable than iron and steel, and suitable to be employed in instruments for dividing soft animal and vegetable substances, used as food in domestic economy, in many of the rural arts. Instruments used for pounding, cutting, rasping, grating, &c. are those alluded to; and for which iron and steel, from their great liability to rust, are often very objectionable.—Three thousand Francs.

ECONOMICAL ARTS.

VII. For the discovery of a substance which can be moulded like *plaster*, and capable of resisting the air as well as stone.—Two hundred Francs.

VIII. For the Preservation of Meats, by drying.—Five thousand Francs.

IX. For the discovery of a Vegetable Substance, either natural or prepared, which may be substituted with ad-

vantage for *mulberry leaves*, in the feeding of silk-worms.—Two thousand Francs.

x. For the best elemementary and practical instruction upon the art of Sounding or Boring for Water, so as to determine the existence of sufficient and permanent springs.—Two premiums, of Three thousand and of Fifteen hundred Francs.

xi. For the best cultivation of Oleaginous Plants.—Twelve hundred Francs.

xii. For the best sowing or planting of the Northern Pine, known under the name of *Lariceo.*

xiii. Ditto, for the best Scotch Pines *(Pinus Rubra).*—Fifteen hundred, and One thousand Francs.

Premiums transferred to the Year 1821.

xiv. For the construction of a machine for Shaving Skins employed in *hatting.*—One thousand Francs.

xv. For the fabrication of Steel-Wire fit for needles, that shall be equal to those imported.—Six thousand Francs; provided the quantity of wire, produced in the manufactory by the first of May, shall have amounted to Ten thousand francs.

xvi. For a process for Dyeing Wool with Madder, of a deep scarlet, without employing cochineal.—Six thousand Francs.

xvii. For the preparation of Flax and Hemp without steeping.—Fifteen hundred Francs.

xviii. For the preservation of Alimentary Substances, by a process analagous to that of Appert.—Two thousand Francs.

xix. For the discovery, in France, of a quarry of Stone suitable for lithographic printing.—Six hundred Francs.

xx. For the construction of a Mill for cleaning Buck-wheat.—Six hundred Francs.

Premiums for the Year 1822.

xxi. For the construction of a Machine for working Optical Glasses.—Two thousand Five hundred Francs.

XXII. For the construction of a Mill for grinding and pounding Grain, which may be adapted to all kinds of rural necessities.—Four thousand Francs.

XXIII. For perfecting the art of preparing Animal Intestines for Cat-gut Strings, &c.—Fifteen hundred Francs.

XXIV. For the fabrication of Bar-Copper for the use of Gilders.—Fifteen hundred Francs.

XXV. For Wool best adapted to the use of Hatters.—Six hundred Francs.

XXVI. For the best Memoir on the most advantageous mode of raising Merino Sheep, and of Cross-breeding with those that are indigenous to France.—A Gold Medal of the value of three hundred Francs.

XXVII. For the fabrication of Sewing-Needles.—Three thousand Francs.

XXVIII. For the application of the Steam Engine to the art of Printing.—Two thousand Francs.

XXIX. For Tinning Looking-Glasses by a method different from that in common use.—Two thousand four hundred Francs.

XXX. For the preparation of Animal Charcoal from other substances than bones; and the purification of Animal Charcoal that has been already employed.—Two thousand Francs.

XXXI. For the preparation of Fish-Glue (Ichthyocolla).—Two thousand Francs.

XXXII. For the construction of a Hand-Mill for shelling Leguminous Seeds.—One thousand Francs.

XXXIII. For the preservation of Woollen Stuffs.—Three thousand francs.

XXXIV.—For the preparation of Paper from the Bark of the Paper-Mulberry.—Three thousand Francs.

REMARKS.

We have imagined that our Readers will be gratified in the perusal of this list, as it serves to show the warm interest which is felt in a nation with whom we are on terms

of friendly and profitable intercourse, in the advancement of the useful arts. The generous labours of the *Societé d'Encouragement*, of Paris, afford a powerful stimulus to national industry and talents. The premiums which they offer, and the annual exhibitions of the finest productions of the manufactories which they superintend, we should be glad to see imitated generally, having no doubt of the efficacy of such institutions upon national prosperity.

LIST OF PATENTS FOR NEW INVENTIONS,

which have passed the Great Seal, since June 4, 1822.

To Henry Septimus Hyde Wollaston, of Clapton, in the county of Middlesex, Merchant; for a Bolt or fastening, particularly applicable as a night-bolt. Dated June 4, 1822.—To be specified in two months.

To William Huxham, of Exeter, in the county of Devon, Ironfounder; for certain improvements in the construction of Roofs. Dated June 4, 1822.—In six months.

To Henry Colebank, of Broughton Furness, in the parish of Kirkby Ireleth, in the county of Lancaster, Tallow Chandler; for an Engine for the purpose of cutting, twisting, and spreading, of Wick used in the making of Candles; by which a great saving of manual labour is accomplished. Dated June 4, 1822.—In two months.

To John Barton, Deputy Comptroller of our Mint; for a certain Process, for the application of Prismatic Colours to the surface of Steel and other Metals, and using the same in the manufacture of various Ornaments. Dated June 4, 1822.—In two months.

To James Frost, of Finchley, in the county of Middlesex, Builder; for a new Cement or Artificial Stone. Dated June 11, 1822.—In two months.

To William Feetham, of Ludgate Hill, in the city of

London, Stove-Maker, and Furnishing Ironmonger; for certain improvements on Shower Baths. Dated June 13, 1822.—In six months.

To Denny Gardner, of Edmund Place, Aldersgate Street, in the city of London, Manufacturer; for his invention of a Stay, particularly applicable to Supporting the Body under spinal weakness, and correcting Deformity of Shape. Dated June 13, 1822.—In two Months.

To Joseph Wass, of Lea Wharf, in the Parish of Ashover, in the county of Derby, Millwright and Lead Smelter; for a certain improvement, which prevents the ill effects to vegetation and animal life, that have hitherto been occasioned by noxious fumes and particles that arise from smelting or calcining Lead-ore and other pernicious Minerals. Dated June 15, 1822.—In six months.

THE

TECHNICAL REPOSITORY.

XX.—*On the Use of the Blow-pipe in Chemical Analysis, and in the Examination of Minerals. By* J. J. Berzelius. *

"The subject of the work now offered to the Public," says the author, very truly, in his Introduction, "is highly interesting to the practical chemist, the miner, and the mineralogist: it is a system of chemical experiments made in the dry way, as it is called, and almost always on a microscopic scale; but which presents us in an instant with a decisive result." It is not less true, that the way in which he has treated it, is as satisfactory as the subject is important. Mr. Children observes, in his Preface, "The name of Berzelius, as a skilful and patient experimenter, stands almost unrivalled; and the present essay amply vindicates his claim to the high reputation he has acquired. It is an invaluable collection of important and new facts; and admirably supplies the want, which has long been felt and acknowledged, of a scientific practical treatise on the blow-pipe." (Translator's Preface, p. v.)—The observation is just in every respect.

The subject is treated in the following order. History of the blow-pipe—Description of the blow-pipe—The combustible—The blast and flame—The support—Additional instruments—The re-agents and their use—The habits of the pure alkalies, earths, metallic oxides, sulphurets, alloys and

* From the Review of the Translation from the French of M. Fresnel, by J. G. Children, F.R.S. &c. *London*, 1822, in the *Journal of Science, Literature, and the Arts*, No. xxvi.

acids, before the blow-pipe;—and the pyrognostic characters of minerals and urinary calculi.

Lamps are recommended to be used with the blow-pipe, in preference to candles; as "the radiant heat from the substance under examination melts the tallow or wax, and occasions them to burn away too fast; and besides, common candles do not always furnish sufficient heat. The best fuel for the lamp is olive oil."

Under the head "*blast* and *flame*," are given very ample and accurate directions how to keep up a steady blast, and produce a strong heat; and the following instructions for oxidation and reduction are very important.

"*Oxidation* ensues when we heat the subject under trial before the extreme point of the flame, where all the combustible particles are soon saturated with oxygen: the further we recede from the flame, the better the oxidation is effected, (provided we can keep up sufficient heat): too great a heat often produces a contrary effect, especially when the assay is supported by charcoal. Oxidation goes on most actively at an incipient red heat. The opening in the beak of the blow-pipe must be larger for this kind of operation than in other cases.

"For *reduction*, a fine beak must be employed; and it must not be inserted too far into the flame of the lamp: by this means, we obtain a more brilliant flame, the result of an imperfect combustion, whose particles, as yet unconsumed, carry off the oxygen from the subject of experiment, which may be considered as being heated by a species of inflammable gas. If in this operation the assay become covered with soot, it is a proof that the flame is too smoky, which considerably diminishes the effect of the blast. Formerly the blue flame was considered as the proper one for the reduction of oxides, but this idea is erroneous: it is, in reality, the brilliant part of the flame which produces de-oxidation: it must be directed on the assay, so as to surround it equally on all sides, and defend it from the contact of the air."

"A very advantageous mode of practice, in order to acquire the art of making a good reducing flame, is, to fuse a small grain of tin, and raise it to a reddish white heat on a piece of charcoal, so that its surface may always retain a metallic brilliancy. Tin has so great a tendency to oxidation, that the moment the flame begins to become an oxidating one, it is converted into an oxide of tin, which covers the metal with an infusible crust. We must begin by operating on a very small grain, and gradually proceed to larger and larger. The greater the quantity of tin that he can thus keep in a metallic state, at a high temperature, the more expert is the operator in his art."

The supports are, charcoal, platinum foil, platinum wire, plates of mica, glass tubes open at both ends, and glass matrasses.

The best of these, except in particular cases, is the platinum wire; and we can confirm, by our own experience, its superior convenience. "The diameter of the platina wire is abitrary: the finest is the best, provided it be thick enough not to bend with the blast: if too thick, it absorbs too much heat." We find a wire of one-hundredth of an inch in diameter answer the purpose excellently. The mode of using it is thus described: It is to be "bent at one end into a hook, which serves as the support, in the following manner. Having moistened the hook with the tongue, it is to be dipped into the flux, a portion of which will adhere to it; this is to be fused by the lamp into a globule, which congeals and adheres to the curvature: the assay must then be moistened, to make it adhere to the flux, which is now solid, and the whole heated together. We thus obtain an insulated mass, which may be conveniently examined, without danger of our being deceived by the appearances which sometimes ensue on charcoal from the play of colour, when the assay globule is detached on a black ground. This method is superior to either of the preceding; and so completely answers the purpose, that, in most cases, the platina wire is preferable

to charcoal, especially when the reduction of a metallic oxide is to be avoided. Generally speaking, all oxidations should be performed with the platina wire, as well as those reductions in which change of colour is the only object in view."

"*Plates of mica* may be used in roasting ores, when the de-oxidating effect of charcoal on the parts of the assay in contact with it might be injurious."

"GLASS TUBES.—When it is necessary to roast a substance, to ascertain what it is combined with, I use a glass tube, two inches long at least, and about one-eighth of an inch in diameter, and open at both ends: I introduce the assay into it, at a little distance from one of the ends; and, according to the temperature required, I heat the tube either with the spirit lamp or with the common lamp, by means of the blow-pipe, inclining it more or less (the part containing the assay being held downwards) as it is necessary to pass a more or less rapid current of air over the assay. The volatile substances, not permanently gaseous, sublime and condense in the upper part of the tube, where their nature may be ascertained."—When charcoal is used as the support, the author directs the assay to be laid with its flux on "one of the ends, perpendicular to the layers of the wood: if placed on the section parallel to the layers, it would spread over the surface. Although the space between the woody layers may consume faster than the layers themselves, there is this advantage attending it, that the assay rests, in that case, merely on their summits, and thus often has only two or three points of contact with the charcoal."

The re-agents are, carbonate of soda, borax, salt of phosphorus (double phosphate of soda and ammonia), saltpetre, vitrified boracic acid, gypsum and fluor spar, nitrate of cobalt, tin, iron, lead, bone-ashes, silica, and oxide of copper. The three first are the principal; the others are only wanted occasionally. It is absolutely necessary that the re-agents should be quite pure; for obtaining them in which state, and the method of applying them, ample directions

are given: those respecting the use of soda are very minute and valuable. This re-agent is of great service, in the fusion of bodies, and the reduction of metallic oxides. Gahn's method of discovering very minute portions of metal, reduced on charcoal by means of soda, deserves particular attention.

Borax is employed to effect the solution or fusion of a great number of substances. Its use is "founded on the tendency of its component parts to form compounds that are all fusible, though in different degrees. On one hand, it dissolves bases, and forms with them a fusible double salt with excess of base: on the other, it dissolves acids, (among which I place silica, and even, to a certain extent, alumina,) and forms with them acid and fusible double-salts. As all these salts commonly preserve their transparency in cooling, we can hence judge the more certainly of the colour which the compound acquires from the substance dissolved."

Salt of phosphorus "acts as a re-agent, principally by means of its free phosphoric acid; and the advantage of employing this salt, rather than the acid itself, is, that the latter is very deliquescent, much more costly, and is readily absorbed by the charcoal. The salt of phosphorus, therefore, shews the action of acids on the assays: its excess of acid seizes on all their bases, and forms with them more or less fusible double-salts, whose transparency and colour may then be examined. Consequently, this flux is more particularly applicable to the examination of metallic oxides, whose characteristic colours it developes much better than borax.

"The same flux exerts a repellent action on acids. Those which are volatile sublime, whilst the fixed acids remain in the mass, and divide the base with the phosphoric, or yield it entirely to it: in the latter event, they remain in suspension in the glass, without dissolving in it. In this respect the salt of phosphorus is a good re-agent for the silicates;

it sets the silica free, which then appears liquefied in the salt, as a gelatinous mass.

"Saltpetre is useful in detecting small portions of manganese;—vitrified boracic acid, in conjunction with iron, for ascertaining the presence of phosphoric acid;—gypsum and fluor spar are used mutually to detect each other, and have no other use. Nitrate of cobalt, in solution in water, is employed to ascertain the presence of alumina and magnesia: with the former it gives a blue colour, with the latter a pale-rose colour: the directions given for applying this test must be carefully attended to, to avoid equivocal results. Tin, in the state of foil, is used to promote the reduction of metallic oxides;—iron, to precipitate certain metals, as copper, lead, nickel, and antimony, and to separate them from sulphur or fixed acids. Lead is employed in cupellation with bone-ashes.

"The bone-ashes must be reduced to a very fine powder; a small quantity of which is to be taken on the point of a knife, moistened with the tongue, and kneaded in the left-hand, with a very little soda, into a thick paste. A hole is then made in a piece of charcoal, and filled with the paste; and its surface smoothed by pressure with the agate pestle. It is then to be gently heated by the blow-pipe, till it is perfectly dry. (The soda only assists the cohesion, and may be omitted.) The assay, previously fused with lead, is placed in the middle of the little cupel, and the whole heated by the exterior flame. When the operation is finished, the precious metals are left on the surface of the cupel. This experiment is so delicate, that grains of silver visible to the naked eye, and indeed such as may be collected by the forceps and extended under the hammer, may in this way be extracted from the lead met with in commerce."

Silica, fused into a glass with soda, detects the presence of sulphur or sulphuric acid; and oxide of copper is used to detect the presence of muriatic acid. The application of the last test is very ingenious.

"We fuse oxide of copper with salt of phosphorus into a dark-green globule: we then add the assay, and heat the whole before the blow-pipe. If it contain muriatic acid, the globule is surrounded by a fine blue flame, inclining to purple, which continues as long as any muriatic acid remains in the assay. Not one of the other mineral acids produces a similar phenomenon; and such of them as form cupreous salts, which do of themselves colour the blow-pipe flame, lose that property when combined with the salt of phosphorus. For instance, the earthy mineral, in which the blue carbonate of copper (from Chessy, in France) occurs, communicates an intense green colour to the flame, when heated before the blow-pipe; but when treated with salt of phosphorus previously saturated with oxide of copper, not the slightest colour is any longer perceptible in the flame."

Under the head of *General Rules for Experiments with the Blow-pipe*, much valuable information, as to the size of the assay, and the order to be observed in experimenting, is given, which our limits will not allow us to detail. We recommend a careful perusal of them to our readers.

The next division treats of the phenomena presented by different mineral substances before the blow-pipe. The experiments were made, (as the author assures us in his Introduction,) on pure substances, and present a number of instructive and valuable facts. The effects produced by the fluxes on oxide of titanium, both pure and mixed with iron, and the means of distinguishing it from the glasses of ferruginous tungstic acid, ferruginous antimonious acid, and oxide of nickel, which assume the same shade as ferruginous oxide of titanium in the reducing flame, are very minute and important.

Oxide of cadmium, "on charcoal, is dissipated in a few seconds, and the charcoal is covered with a red or orange-yellow powder. This phenomenon is so marked with oxide of cadmium, that minerals which, like carbonate of zinc, contain one or two per cent. of carbonate of cadmium,

when exposed for a single instant to the reducing flame deposit, at a little distance from the assay, a yellow or orange-coloured ring of the oxide, most distinct when the charcoal is cold. This ring forms long before the oxide of zinc begins to be reduced; and if flocculi of that metal appear at the same time, it is a proof that the blast has been pushed too far; but if we can discover no yellow trace before the fumes of zinc begin to condense on the charcoal, we may conclude that the assay contains no cadmium."

Mr. Children has added the following, in a note, on this subject; which he had from the late Dr. E. D. Clarke. "If platina foil be used for the support instead of charcoal, the yellow or orange-coloured ring is not only conspicuous upon the platina, but, by exposing it to the point of the blue flame, the metal is revived, and afterwards deposited upon the platina, during its combustion, in the form of a protoxide, exactly like polished bronze or copper." *

The method of distinguishing bismuth from antimony and tellurium is very satisfactory; as well as the following, for detecting very minute portions of tin and copper. "With soda, on the platina wire, oxide of tin combines with effervescence, forming an insoluble turgid mass, insoluble in an additional quantity of soda. On charcoal, it is readily reduced into a globule of metallic tin. Some native oxides of tin, especially such as contain columbium, are not easily reduced with soda; so that, on a first experiment, one might doubt its presence; but if we add a small quantity of borax, the reduction is immediately accomplished.

"Tin often occurs in nature as an accidental, and, relatively, very small constituent part of the ores of columbium, titanium and uranium, and perhaps of some others, where its presence would be little suspected in experiments made in the moist way; but when treated with soda in the reducing flame, particularly after separating the iron, metallic tin

* "If we do not mistake, the invention of this process should be ascribed to Dr. Wollaston."—*Note by the Editor of the Journal of Science &c. &c.*

is always detected, even though it enter in no larger proportion than one two-hundredth part of the weight of the ore. If the proportion of iron be inconsiderable, its reduction may be prevented to a certain point, by adding borax to the soda."

Oxide of copper, "with salt of phosphorus, fuses and exhibits the same shades as with borax. If the proportion of copper be inconsiderable, the glass sometimes becomes transparent and ruby red, after exposure to the reducing flame, nearly at the moment of congelation. Commonly, the glass becomes red, and opaque, like enamel. If the quantity of copper be so small that the character of the protoxide cannot be developed by the reducing flame, we add a little tin to the assay (whether the flux be salt of phosphorus or borax), and immediately continue the blast. The before-colourless glass now becomes red, and opaque, on cooling. If the blast be kept up too long, the copper precipitates in the metallic state, particularly with salt of phosphorus, and the colour is destroyed.

"With soda on the platina wire, oxide of copper fuses into a fine green glass, which loses its colour and transparency on cooling. On charcoal, the mass is absorbed, and the oxide reduced. There is probably no other possible method of discovering such minute proportions of copper as may be detected by the blow-pipe, in all cases where it is not combined with other reducible metals liable to disguise its properties. In the latter case, we must employ borax and tin. If copper and iron be found together, the same operation reduces each separately into distinct particles; which may be known by their respective colours, and separated by the magnet."

The methods of examining the sulphurets, arseniarets and alloys, and the characteristic effects of acids, as component parts of salts, are given with equal perspicuity and detail; and the mode discovered by the author of detecting phosphoric acid, by means of boracic acid and iron, is ingenious and useful.

The last division is devoted to the pyrognostic characters of minerals and urinary calculi, and constitutes the largest portion of the work. In order to shew our readers the way in which this important part of the subject is treated, we subjoin an instance taken at random, with which we shall conclude our extracts.

"Chondrodite, from Pargas, Åker, and America. The Brucite of the Americans.* Alone, in the matrass, blackens by heat, but gives no appreciable quantity of water: the black colour disappears by roasting in the open air.

"On charcoal it is infusible. The most ferruginous chondrodite becomes opaque and brown on the points that are most strongly heated. The variety containing less iron, that from Åker, for instance, becomes milky white, by the effect of heat.

"With borax fuses slowly, but completely, into a transparent glass, slightly tinged by iron. If the glass be saturated with the chondrodite, it loses its transparency by flaming; it does not, however, become milky white, by the effect of heat.

"With salt of phosphorus decomposes pretty easily, and leaves a semi-transparent siliceous residuum: the glass is clear and colourless, but becomes opalline on cooling. A small quantity of soda transforms it into a difficultly-fusible grey scoria: with a larger quantity, it intumesces, and becomes infusible.

"With solution of cobalt, in a strong heat, it gives a pale-red colour, not pleasing to the eye. Chondrodite from Pargas gives a brown grey, the action of the iron preventing that of the oxide of cobalt on the magnesia."

The portion of this work devoted to the examination of

* "*Silicate of magnesia.*—Almost all the magnesian silicates contain a combustible substance, which becomes charred when heated in close vessels. If the mineral be then heated in the open air, the charcoal burns away, and the black colour disappears. Steatite is a remarkable instance." B.

urinary calculi, though brief, will be found of great utility and importance, especially to medical men; to whose attention we earnestly recommend it, as "simple and infallible, and requiring no more chemical knowledge than every physician ought to possess."

To this general analysis, and the copious extracts which we have given of the work before us, it is unnecessary to add much more: the latter prove our opinion of its merits; for we should not have thought it necessary to lay so much of its contents before our readers, were we not desirous, by the specimens we have furnished, to induce them to form a more intimate acquaintance with the work itself; and we have no hesitation in assuring them that they will be amply rewarded for their trouble.

REMARKS BY THE EDITOR OF THIS WORK.

We have thought it our duty to lay nearly the whole of this able review before our readers; believing that their opinion of the merits of the original work, and of Mr. Children's translation, will be much enhanced by the sanction afforded to them by the Professor of Chemistry in the Royal Institution. And we shall consider it incumbent upon us to make additional extracts from the translation itself, in the progress of our undertaking.

XXI.—*Analysis of Tutenag, or the White Copper of China.*—*By* ANDREW FYFE, M. D. *Lecturer on Chemistry, Edinburgh, &c.**

VERY different statements have been given of the composition and origin of tutenag, used by the Chinese in the formation of many of their metallic utensils.

According to Keir, it is a white alloy of copper, zinc,

* From the *Edinburgh Philosophical Journal*, No. XIII., *for July* 1821.

and iron, which is very hard and tough, but at the same time malleable, and taking a fine polish. An inferior sort of it, according to the same author, is more of the colour of brass.

De Guigne, on the contrary, states, that its properties, especially that of imparting to copper a white colour, and rendering it less liable to acquire verdegris on its surface, prove that it does not contain zinc. According to him, it is an alloy of iron, lead, and bismuth.

Engestroem, in the Stockholm Memoirs, states, that the *Pak-Fong*, or white copper of China, is composed of copper, nickel or zinc, the last of which amounts to seven-sixteenths of the whole, and the proportions of the two first are to each other as 5 to 7.

Dr. Howison of Lanarkshire was so fortunate, when in China, as to procure a basin and ewer of Chinese or white copper, a part of which he sent me for analysis. From the experiments I have performed on it, I find the composition to be different from what is stated by the above-named chemists; its component parts being copper, zinc, nickel, and iron; the last of which, however, is but small in quantity.

The basin in the possession of Dr. Howison is of a whitish colour, approaching to that of silver; and is very sonorous. When held in one hand, and struck with the fingers of the other, the sound is distinctly heard at the distance of an English mile: it is also highly polished, and does not seem to be easily tarnished. The piece that was sent me I found was malleable at a natural temperature, and at a red heat; but when heated to whiteness, it was quite brittle, breaking with the slightest blow of a hammer. By great caution, it was rolled into thin plates, and was drawn into wire of about the thickness of a fine needle. When fused in contact with the atmospheric air, it oxidated, and burned with a whitish flame, in the same way as zinc does. Its specific gravity at 50° was 8.432.

Five grains of it were subjected to analysis, with the view of ascertaining the proportion of its ingredients: the result was,

Copper - -	2.02	or in the 100 parts,	40.4
Zinc - -	1.27		25.4
Nickel - -	1.58		31.6
Iron - -	0.13		2.6
	5.00		100.00

The method which is practised in preparing white copper is not known in this country; though it seems to be the general opinion that it is procured by the reduction of an ore, containing the ingredients of which it is composed. In a Letter I received from Dr. Howison, he mentions, that Dr. Dinwiddie, who accompanied Lord Macartney to China, shewed him, when at Calcutta, several specimens of the ore from which he was told the white copper was procured, and which he obtained at Pekin. The basin in the possession of Dr. Howison cost in China about one-fourth of its weight in silver; and the exportation of utensils of this alloy is prohibited. These circumstances also render probable the opinion that the white copper is obtained by the reduction of a metallic ore; for in China labour is cheap; and the metals composing it are said to be found in great abundance.

REMARKS BY THE EDITOR.

This communication is of very considerable importance; nickel being now obtained in quantities from the cobalt manufacturers in the Potteries, and much employed, in various metallic compounds, at Birmingham. Tutenag used formerly to be imported pretty largely into this country; and was very much employed in the manufacture of candlesticks and other articles of domestic use, as a substitute for silver; and also for pistol-barrels, which would bear a higher degree of proof than iron barrels. We hope that some manufacturer will soon put this analysis to the test,

and make English tutenag; of the success of which we should be glad to be informed, in order to communicate it to the Public.

XXII.—*On the Improvement of Domestic Telegraphs. By the* EDITOR.

HAVING obtained, since the communication in our last Number, further particulars respecting the Rev. Mr. Hall's Domestic Telegraph, we hasten to lay it before our Readers; together with suggestions for its improvement, as well as for the improvement of all the others described.

It appears that the list of articles in Mr. Hall's telegraph were arranged in four vertical columns; each being numbered at the top, from 1 to 4;—and that, in order to shew in which column the required article was placed, so many distinct pulls of the bell were made:—no particular order or arrangement, however, was observed in the distribution of the articles in the different columns. Now, we consider it would certainly be a very considerable improvement, to borrow the arrangement in Mr. Pearson's American Domestic Telegraph, and to apply it to Mr. Hall's, as well as to Merlin's; that is, to make one column contain a list of such articles as are mostly in request; a second, the alphabet; a third (or even two or three additional columns), a series of numbers, from 1 to 100: and thus these two telegraphs would indeed become exceedingly useful.

Mr. Pearson's telegraph, and the simplified circular ones recommended by the Editor, would likewise be very considerably improved, by extending the circles of numbers: but still more so, by the employment of bells, in Mr. Hall's manner;—or, in case of one telegraph communicating with the other by means of a single metal-rod, that rod might also be made the medium of conveying sound from one to the other, by striking slight blows upon the end of it with any proper hard substance; as hereby the house, ware-

house, office, &c. would be less disturbed by the continual ringing necessary to be kept up by Mr. Hall's method.

The signal for the messuage being understood by the party with whom communication is carrying on, might be made, either by giving to the rod a slight degree of vibratory motion, or by striking it as above mentioned: and, indeed, there is no reason why communications might not be thus equally well conducted, by each party, with the substitution of an inflexible rod, in place of the line used in Mr. Hall's telegraph.

XXIII.—*On the Manufacture of the Tartaric Acid, in France.**

The tartaric acid was discovered by Schéele, in 1770; it was he at least who first published the means of separating it from its compounds: but Duhamel, Margraff, and Rouelle the Younger, had, for some time previous, placed beyond all doubt the existence of this acid in tartar.

This acid cannot be formed, like many other vegetable acids, of vegetable matters indiscriminately, by the re-action of the nitric acid: it exists in the juices of many fruits, and particularly in those of grapes and tamarinds, but not sufficiently uncombined to be easily extracted. One vegetable product alone contains it in large quantity, and furnishes us with the means of procuring it; this is, the tartar deposited in the casks which contain wine: the tartaric acid is here combined with potash, and forms a super-salt, which is called the *acid tartrate of potash*, or *bi-tartrate of potash*, because this salt contains double the quantity of acid necessary to saturate its base.

The method which Schéele has published, and which is the only one that can be employed to obtain this acid, is the same with that used to procure the citric acid (which has been fully described by Mr. S. Parkes, in his Chemical

* From the *Dictionnaire Technologique*.

Essays): the same means, the same precautions, in a word, the same process entirely, must be employed in the manufacture of the tartaric acid: of course, it becomes superfluous to repeat it, and we need therefore only speak of the difference in the results which we obtain in the two cases.

The tartar, as we have before said, is a super-salt: we may therefore consider its acid as existing under two forms; one portion as being completely saturated by its base; and another portion will be found, as we may say, in a free state. In fact, when we decompose this salt, the following circumstances take place; and the proof is, that we can separate one of these two parts without touching the other;—which is a fortunate circumstance; for, were it otherwise, the preparation of this acid would become much more expensive. If we would subtract that portion of the tartaric acid which is in a free state, we must not add to it pure alkali; but if, by means of a base, we would deprive it of all the acid, to unite it to this base and to transform it into insoluble tartrate, then the potash, freed from the combination, would remain in the liquor in a caustic state. It may have a re-action sufficiently powerful on the insoluble tartrate to prevent it from precipitating: and it should be observed, that this always occurs when the tartar is treated with lime. The tartrate of lime which is formed is retained in solution by the caustic potash; and if the whole be evaporated, nothing is obtained but a gelatinous mass, semi-transparent, and resembling, in its appearance, soap melted in a small quantity of boiling water. We are then obliged to commence with removing that portion of free acid, by employing chalk; that is to say, water is heated in a common bason; some pinches of pulverized cream of tartar are thrown into it, and the chalk is sifted uniformly over the surface of the liquid through a hair-sieve, and immediately stirred with a wooden spatula; effervescence is thus produced, the tartrate of lime is precipitated, and there remains in the liquid the neutral tartrate of potash. We thus

add, successively, cream of tartar and chalk, till the whole quantity designed to be operated upon is employed. Concerning the respective proportions of these two salts, we must be guided by the disengagement of the carbonic acid. So long as effervescence is produced, chalk is to be added; of which about four parts in ten is consumed. The tartrate of lime is afterwards washed; and then decomposed by a quantity of sulphuric acid, equal to that of the chalk employed. We must be particularly careful that the citrate of lime be decomposed in sulphuric acid, diluted with from three to four parts water; and every thing else is managed exactly as we have already directed.

The solutions of the tartaric acid do not crystallize till they attain from 36 to 38 degrees of the areometer; they then become so viscous, that the particles are separated with difficulty. The crystallization of this acid is best performed by the well-regulated heat of a water-bath, because then the liquid may be preserved in a state rather more fluid. The acid thus obtained is not pure; it still contains a considerable quantity of sulphuric acid, and is generally too much coloured to be used in this state: it is purified by being submitted to a second, and sometimes to a third crystallization; but then the crystals are less detached, and less regular than at first: the addition of a small quantity of animal charcoal contributes to give them a more brilliant whiteness. If we would obtain this acid perfeetly pure, that is to say, entirely free from the least portions of sulphuric acid, it is requisite to crystallize it repeatedly, until the precipitate which it forms in the solutions of salts of barytes or of lead shall be completely soluble in the pure nitric acid. It has been proposed, as a better means of purifying it, to use vitrified litharge; to be added to the solution of tartaric acid, and to be stirred frequently until the sulphuric acid shall be entirely separated. Through this solution a stream of sulphuretted hydrogen is afterwards passed, to separate from it the oxide of lead which has been dissolved: it is then heated, filtered, and evapo-

rated.—(The writer has seldom seen this method succeed well.)

We have observed, that, in the use of chalk, the excess only of the acid is separated, and that in the liquid there still remains the neutral tartrate of potash: part of this salt may be separated by adding to the concentrated solution a proper proportion of sulphuric acid. The potash divides itself between the two acids; so as to form, on the one hand, sulphate of potash, which dissolves; and, on the other, an acidulous tartrate, which, being somewhat soluble, is deposited in small granular crystals. This cream of tartar is afterwards treated as in the former case. Another means is also employed for obtaining the acid from the tartrate of potash: they decompose it by muriate of lime, when they happen to have it in great abundance. The two acids reciprocally change their bases; that is, they form tartrate of lime and muriate of potash. The acetate of lime may be employed for the same purpose, and with as much advantage.

The crystalline form of the tartaric acid has not yet been determined: we can never obtain regular crystals of it, but either masses or crystalline crusts, from whence proceed points which appear to be tetrahedral prisms. The taste of this acid is very strong; but it is pleasant, and has nothing austere in it. When it is burnt upon live coals, it detonates considerably, and emits the odour of caramel (or burnt sugar). If it be heated in a close vessel, it decomposes; and affords, besides the products furnished by all other vegetable matters under the same circumstances, a particular acid, susceptible of crystallization, which has been called *pyro-tartaric* acid. That which more particularly characterizes the tartaric acid, and by which it is well known, is the property it possesses of producing immediately a precipitated crystalline cream of tartar, by pouring it in excess into a concentrated solution of potash. This experiment is sometimes made, by using the neutral tartrate of potash, instead of potash; which is wrong;

because most of the acids separate from the cream of tartar, carrying off a portion of its base. Both in medicine and the arts, many combinations of the tartaric acid are employed with the alkalies or metallic oxides; and particularly the simple tartrates of potash, of soda, and of iron, and the double tartrates of potash and soda, potash and iron, and potash and antimony.

The nature of the tartaric acid is yet but little known: it appears that it may be found in the same manner as the oxalic acid, and that it has, like that, a component base. The following, however, are the comparative results of the analysis of tartrate of lime and tartrate of lead.

MM. Thenard and Gay-Lussac, by analysing tartrate of lime, have found that the tartaric acid was formed of

Hydrogen	6.629
Carbon	24.050
Oxygen	69.321

M. Berzelius has deduced, from an analysis of tartrate of lead, that the same acid contained

Hydrogen	3.951
Carbon	36.167
Oxygen	59.882

M. Berzelius supposes that the tartrate of lime employed by MM. Thenard and Gay-Lussac contained 34.54 in an hundred of water; but it is most probable that this enormous difference arose from a peculiarity of the tartaric acid in these two salts.

The uses of the pure tartaric acid are very numerous; because it is substituted, on account of being of less value, for the citric and oxalic acids, whose properties, in a great measure, it possesses. Hence it is employed in calico-printing; and is also frequently used in the making of lemonades, &c. R.

XXIV.—*On the Manufacture of Oxalic Acid, in France.*

(Continued from p. 66.)

On subjecting any kind of vegetable matter whatever to the action of nitric acid, we know that the acid is decomposed with more or less rapidity, according to the quantity of acid employed, its degree of concentration, the temperature of the atmosphere, and the nature of the substance on which it acts: the products of this decomposition are extremely varied, and equally depend on the influence of other causes which we shall presently describe. In this operation, it is, therefore, essentially requisite to have regard to all these circumstances, in order constantly to obtain advantageous results. It is not sufficient that we always employ the same proportions exactly of nitric acid and sugar, to obtain the same quantity of oxalic acid; it must also be used exactly in the same manner. M. Chaptal, in his "*Chemistry applied to the Arts*," advises to take nine parts of common nitre and one part of sugar; to mix them together, and submit them to the action of heat. The re-action is then most lively; it disengages a considerable quantity of nitrous vapours, and produces oxalic acid in much greater proportion than if the nitric acid had been added by degrees; because, according to the same author, the decomposition is more complete, and a less quantity of malic acid is formed. It must be confessed, that, in spite of the confidence which we might be induced to place in the results announced by M. Chaptal, we can scarcely believe it to be as he states. We have always found it preferable, and in fact more efficacious, to employ the nitric acid in small quantities at a time; as, otherwise, the oxalic acid is decomposed as fast as it forms. The inconvenience which is said to attend the production of malic acid is not so in reality; since it transforms itself into oxalic acid, on being submitted to the action of a fresh quantity of nitric acid. The method found best to succeed, is this: On 24 pounds of starch divided in several tubulated retorts arranged on a common

sand-bath, 72 pounds of ordinary nitric acid are poured, and left to act: the starch very soon dissolves, decomposition commences, and nitrous gas is formed in great abundance. When the action is terminated, 24 pounds of nitric acid are added, and a gentle heat applied: the red vapours again appear; and a moderate degree of heat must be kept up during the re-action. The liquid is afterwards poured into earthen pans, and left to crystallize: we thus obtain, in the first instance, about five pounds of oxalic acid. We then put together the mother-waters, heat them, and add by degrees 24 pounds of nitric acid: which second operation affords nearly two pounds eight ounces of crystals. The same treatment of the mother-waters is to be repeated a third, and a fourth time. The total produce of the purified oxalic acid nearly equals the half of the starch employed: and the entire acid consumed is equal to a sixth part. The purification to which the oxalic acid is submitted consists in simple solution and crystallization, to free it from the nitric acid with which it is impregnated.

In treating on the sulphuric acid, we have explained a process which also furnishes the oxalic acid; but as this is only a secondary product, and as the principal aim is to form the nitrous gas to serve in the transformation of the sulphurous into the sulphuric acid, so we do not take the necessary precautions to obtain the more advantageous results of that process, wherein we are directed to put all the nitric acid at once on the melasses. To this process, however, imperfect as it is, we must attribute the low price of the oxalic acid. It is easy to afford a reason for this, on reflecting that the nitrous gas, which is formed in this case, well pays, by the quantity which it affords, for the nitric acid employed; and, consequently, the oxalic acid which is thus obtained costs nothing, or nearly nothing.

In Switzerland, the manufacturers of printed linens have recourse to another means for procuring the oxalic acid: they extract it from the salt contained in the *oxalis*, or

wood-sorrrel, and the *rumex acetosella* or sorrel, plants which grow abundantly in that country, and which for many years have been an object of particular cultivation.

By the following process, they decompose the salt of sorrel (acid oxalate of potash) by the acetate of lead; and the oxalate of lead, which results therefrom, by the sulphuric acid. For this purpose they dissolve 50 kil. of salt of sorrel in 12 to 15 parts of boiling water; and, apart from this, they also dissolve 150 kil. of acetate of lead in cold water. These two solutions are mixed by degrees, and a very strong action takes place: they are then left at rest a sufficient time, and the liquor is drawn off: the residuum or settling is washed over four or five different times, until the precipitate is freed from every extraneous substance; then poured into earthen pans or stone jars, and treated with weak sulphuric acid. For the proportion of salt which we have indicated, they take from 37 to 50 kil. of sulphuric acid, which they dilute with five or six parts of water; and, to profit by the heat produced from this mixture, it is to be made at once, and instantly poured on the oxalate of lead: the whole to be well stirred from time to time. To be assured of the success of this operation, it is well to assay a small portion of the filtered liquor by the test of the muriate of barytes: if the precipitate formed is almost wholly soluble both in pure and diluted nitric acid, it is a certain sign that the decomposition is effected: on the other hand, they allow the acid to remain a much longer time, and sometimes even pour the mixture into a leaden boiler and slightly heat it. When they judge that the operation is terminated, they decant it; and wash the residuum in hot water, till the washings be no longer sensibly acid. All the liquors are next mixed together, and then evaporated, till they acquire a little consistence, and become more viscid: they then withdraw the fire; and obtain, on cooling, the oxalic acid, crystallized in needles intermixed with each other.

It generally happens that the oxalic acid obtained by

this process only takes the form of needles, or of very short and small prisms; whilst that produced from vegetable matter, treated by the nitric acid, affords long quadrilateral prisms, sometimes nearly two inches long. It appears that this difference is caused by a remainder of the extractive matter contained in the salt of sorrel, from which it can only be freed by precipitations and washings. One thing is certain, that this inconvenience may be obviated, if it may be called an inconvenience, by adding to the liquor, towards the end of the evaporation, for each kil. of the salt of sorrel employed, about 100 grammes of nitric acid, at 5° of the areometer, diluted with nearly six parts of water. By means of heat, the nitric acid acts on the matter which opposed the crystallization; and the oxalic acid is thus obtained in beautiful prisms.—By this process, an hundred parts of salt of sorrel, of a good quality, gives seventy-five of oxalic acid.

In this double decomposition of the quadroxalate of potash by the neutral acetate of lead, we obtain, on the one hand, the insoluble oxalate of lead, and, on the other, the acid acetate of potash which remains in solution. When we operate in the large way, we may withdraw part of this acetate, and finish the saturation with lime; then evaporate, and treat the dry acetate with sulphuric acid, to obtain acetic acid. The residue of this decomposition is formed of sulphate of lime and sulphate of potash, which may be separated by simple lixiviation.

This vegetable acid possesses some remarkable properties, which we shall here briefly point out; as on them depend general considerations of great interest. It has, like all other acids, a sharp taste: it reddens litmus, &c. &c. It not only forms salts with divers bases, but, according to the observations of Dr. Wollaston, it may be combined with the same oxide in four different proportions; so that we find amongst them, sub-oxalates, neutral oxalates, acidulous oxalates, and acid oxalates; and we have seen that the quantities of oxalic acid necessary to form these different

degrees of combination will be found in the proportions of 1, 2, 4, 8, to the same quantity of the base; as the acidulous oxalate contains twice as much acid as the neutral oxalate, and the acid oxalate contains a fourth; whence arise the expressions, *bi* and *quadroxalates*. The salt of sorrel is of the latter class. One very singular property of the oxalic acid, and which leads to uncertain results, is that discovered by M. Dulong. This acid, entirely deprived of water, and such as is obtained by sublimation, combines without loss, with several bases; and loses from 20 to 100 in combining with others, especially with the oxides of lead and zinc. Moreover, these two oxalates, when well dried, afford no traces of hydrogen in the products of their analysis by fire: we can only detect the carbonic acid, and the metal in its metallic state. Sometimes, however, the carbonic acid is mixed with a little gaseous oxide of carbon, but then the metal will be found united with a small proportion of oxide also.

We see, therefore, after all that has been said, that these salts are formed of a metal, and the elements of the carbonic acid; and yet, when they are decomposed by the hydrosulphuric, the sulphuric, the hydrochloric, and other acids, we obtain, in the liquid, the common oxalic acid. M. Dulong has proposed many hypotheses to account for these phenomena: in one hypothesis, he supposes that the sublimed oxalic acid contains about a fifth of its weight of water; that this water may be disengaged from certain salts, and retained by others; and that the acid admits carbon and oxygen into its composition only in the intermediate proportions to those which constitute carbonic acid and the gaseous oxide of carbon. In a second hypothesis, M. Dulong considers the oxalic acid as formed of carbonic acid and hydrogen: in this case, that which has been sublimed will not contain water; and that obtained by the calcination of several oxalates will result from the combination of the hydrogen with the acid of the oxygen of the base: so that

the oxalic acid would be a true hydracide, of which the carbonic acid will form the foundation.

We are fearful of outstepping the limits allowed to us by entering into longer details; but we cannot repeat too often, that the most complete study of the nature of this acid would necessarily lead to important results on the nature of vegetable acids.

We terminate this article by observing, that previous to the fine experiments of M. Dulong the nature of the oxalic acid was not understood; so very different were the results obtained by the most celebrated chemists.

According to the analysis of MM. Thenard and Gay-Lussac, the oxalic acid contains	Carbon . .	26.66
	Oxygen . .	70.689
	Hydrogen .	2.745
And according to M. Berzelius,	Carbon . .	33.35
	Oxygen . .	66.41
	Hydrogen .	0.24

This discrepancy, however, is perfectly explained, when we see that it is owing to the two different states of the oxalic acid, arising from its several combinations. MM. Thenard and Gay-Lussac analysed the oxalate of lime, and M. Berzelius the oxalate of lead. R.

XXV.—*On various Processes employed in Jewellery.* *By the* Editor.

[Continued from p. 65.]

On the Boil, for Gold Work.

It is a very curious circumstance, that the best workmen in this branch of jewellery have at this day no other menstruum for giving the last high finish in colour to their beautiful articles, than the employment of the compound salts of alum, nitre, and common salt, wherewith to form a sort of aqua-regia, or nitro-muriatic acid; instead of employing the nitro-muriatic acid itself:—such, however, is the fact.

They put into a crucible one part, by weight, of alum (sulphate of alumine), two parts of nitre (nitrate of potash),

and one part of common salt (muriate of soda), with a very little water; and make it boil over the fire in the forge-hearth. When the salts are dissolved, chiefly in their own water of crystallization, the articles, previously strung upon a platina wire hooked together at its ends, are put into the boil, as it is termed, and frequently taken out from time to time, and washed in water, to see when the proper effect is produced; which is longest in taking place in those parts which are united by soldering.

In this mode, the copper, or silver, which entered into alloy with the gold forming the articles, are dissolved; and the surface of the articles appears of a true gold colour only.

This process, or one differing from it only in the proportions of the three salts, has long since been published in Smith's "*Laboratory, or School of Arts,*" as a solvent for gold; equal parts of each salt being employed: and in this way the Editor succeeded in readily dissolving leaf-gold; the salts becoming tinged of a deep yellow colour, and the fumes of the nitro-muriatic acid extricated most copiously. He also succeeded, by the employment of French brandy, in taking up the gold from its solution, leaving the salts perfectly white; and thus forming, as it were, an ethereal solution of gold. It is, however, most certainly an improvement, to double the quantity of the nitre.

TO RECOVER THE GOLD FROM THE WASHINGS OF THE BOIL.

Strange as it may appear, yet it is a fact, that, till very lately, the jewellers constantly threw away the water into which they had dipped the articles taken out of the boil, without being at all aware of the quantity of gold they also threw away with it! Latterly, however, a person possessed of more chemical knowledge, has made a considerable benefit by instructing the jewellers, at the price of five guineas each, in the method of recovering that gold which heretofore they had so very thoughtlessly wasted. His process is as follows:

The water is put into a large earthen-ware pan, kept constantly covered, and a solution of copperas (sulphate of iron) is added to it: the gold soon appears, in the form of an impalpable powder; and, when a sufficient quantity is separated (in a week's time for instance), and when no turbidness is produced on adding more of the solution of copperas, the water is poured off, and the sediment put by to dry; the sediment being preserved from time to time, until a sufficient quantity is collected to be fused in a crucible, with the addition of nitre to oxidate the iron. The gold is thus obtained in a state of purity.

ON FORMING THE GOLD BEADS USED IN FILAGREE-WORK, &c.

These are made by boring shallow conical holes with a toothed rimer, all over the surface of a piece of flat charcoal; and, according to the intended size of the beads, putting into each hole, two, three, or more rings of gold wire, formed by wrapping the wire around a cylinder of about a quarter of an inch in diameter, and then cutting the helical coil of wire into single rings, each containing a similar quantity of gold, which is the object of coiling and cutting the wire into rings. These being submitted to the action of the flame of the lamp, urged by the blow-pipe, quickly fuse, and unite together into small globular beads.

ON MELTING GOLD AND SILVER ON CHARCOAL, AND CASTING THEM INTO SHAPE.

The jewellers avail themselves of the exceedingly slow conducting power of charcoal for heat, to melt a considerable quantity of gold or silver occasionally, without the employment of a crucible, or the use of a forge-hearth or wind-furnace. To effect this, they saw asunder, lengthways, a cylindrical piece of sound charcoal, and rub flat both faces. The charcoal ought to be at least two inches in diameter, and seven or eight inches long. Near the end of one of the pieces, they excavate a hemispherical cavity, large enough to hold the scraps of gold or silver which they

intend to melt, together with a sufficient quantity of borax to flux them. Between the two prepared surfaces of the charcoal, a flat piece of copper, or other proper metal, is then put, of a thickness equal to that of the mass to be cast, and having a cavity made in the end of it, of the shape to be given to the gold to be cast, and opening at the end, outwardly: this is smoked all over, by being held over the flame of a lamp, previous to its being placed between the two pieces of charcoal; and the whole is bound firmly together with iron binding-wire.—It should be observed, however, that, previously to placing the metal mould between the pieces of charcoal, a slit or channel must be cut, leading from the hemispherical cavity in the charcoal to the mouth of the mould.

When all is ready, the flame of the lamp is directed, by means of the blow-pipe, upon the gold or silver in the cavity; and the heat continued until the metal is melted; when, by inclining the charcoal, it flows directly into the mould.

A variety of moulds are of course provided; and thus small quantities of gold or silver are cast into various forms, with great convenience.

OF THE JEWELLER'S LAMP.

This is of a very simple and convenient form, being made on the principle of the bird-fountain; that is, having an air-tight reservoir at its back, to hold a supply of oil, and a cup to receive it; and always containing an equal depth of oil, which is regulated by the situation of the hole made at the bottom of the reservoir, where the oil enters the cup. In the front of the cup, a spout is fixed to receive the cotton-wick of the lamp, which is of the thickness of a finger. The front of the spout forms a tube; but the back of it is open at the top, for the purpose of pushing the wick outwards, by means of the beak of the blow-pipe, when the lamp is to be used; or of retracting it nearly within the end of the spout, to keep it merely alight during the time it

is not in use, and thus avoiding an useless waste of oil. This lamp is supported upon a stand or foot, of a convenient height for use.

[*To be continued.*]

XXVI.—*On the Microscope. By the* Editor.

[Continued from Vol. I. p. 446.]

IMPROVEMENT IN VIEWING EXTEMPORANEOUS TRANSPARENT OBJECTS.

The general directions given for viewing transparent objects, are, to place them between two glass slips; and to put the whole under the springs of the stage of the microscope, to confine them closely.

In this way, however, the thickness of the uppermost glass slips is so great, that it is impossible to view the objects under high magnifying powers. But, in order to remedy this evil, the Editor has lately substituted, with great success, a slip of mica, or talc, instead of the uppermost glass slip; and can thus readily employ lenses of the one-30th or one-50th of an inch focus; on the great advantages of which it is quite needless to enlarge.

ON THE REMOVAL OF THE GLARE OR GLITTER PRODUCED BY THE EMPLOYMENT OF BRILLIANT LIGHTS, IN VIEWING OBJECTS IN THE MICROSCOPE.

It is well known, that the best light for viewing objects distinctly is that afforded by a white cloud: as, however, this is not to be obtained at all times, and as it is therefore necessary to employ the light of the sun, or of a lamp, candle, &c. to illumine the objects, so it is exceedingly desirable to free their images from the prismatic colours, which always accompany them, when the above means of illumination are employed.

The Editor finds, that when one side of the convex lens used for concentrating the sun's light upon the object is either left unpolished, or afterwards greyed, by the employment of the *finest* washed emery in the grinding tool; or if

a flat glass, *very finely greyed* by the same means, be placed in the cell in the middle of the stage, under the objects; that all the good effects produced by the light from the cloud can be obtained at all times, and with a superior degree of brilliancy.

It is impossible to conceive what a wonderful degree of accuracy and clearness in the magnified images of objects are obtained by this simple contrivance; especially in the compound microscope, where, as is well known, the images lose much of their distinctness, from the false glare with which they are generally surrounded; and which it is impossible to free them from, by any of the usual methods.

[*To be continued.*]

XXVII.—*On the Cambridge Students' Lamp. By the* EDITOR.

WITH A PLATE.

THIS lamp was invented by the late Rev. Isaac Milner, D.D. F.R.S. F.A.S. Dean of Carlisle, President of Queen's College Cambridge, Lucasian Professor of Mathematics, &c. &c.: and many years experience of its superior advantages, as an exceedingly convenient and economical table-lamp for reading or writing by, fully justify the Editor in recommending it to the favourable notice of the public.

Plate III. fig. 1, is a perspective view in front of the lamp; and fig. 2, a side view of it, without its base; drawn to a scale of one-third the real size. Fig. 3, is a plan, and fig. 4, an elevation of the body of the lamp, drawn to a scale of one-half the real size, to shew that part more distinctly; and figs. 5, and 6, are front and side views of the wick-holder, drawn to the same scale as figs. 3 and 4. A, in all the figures, is the body of the lamp, being a flat circular box to contain the oil; made of tinned iron-plate, japanned, four inches in diameter, and one inch deep; having a circular gap, B, on one side of it; across which gap the burner C is fixed, in the manner shewn in fig. 3. In the middle of the body A, a piece of brass tube, D, is sol-

dered; each end of which is sawn twice across; thus making four slits therein, the solid parts of the tube between which, are bent a little inwards, so as to form as many springs.

On the side opposite to the circular gap B, is made a hole, E; with a short tube or neck soldered in it, on which a cap or cover, having a hole in its top, is fitted.

The springing tube D slides up and down upon the cylindrical stem F, made of stout iron-wire; the lower end of which is firmly rivetted into the cast-iron base or foot G; the bottom of which has three gaps made around it, leaving as many solid parts between them, forming feet, as shewn in fig. 7, to enable it to stand more firmly: a brass ring or handle, H, is also screwed at its top; and a hood or shade, I, shewn in front in fig. 1, and sideways in fig. 2, (a plan of which is shewn in fig. 8,) slides up and down upon it, by means of a spring-tube, similar to that described at D in the body A: and a wire support, with a ring above and hook below, J, for the cylindrical glass chimney, K, to rest on, completes the lamp.

It will be seen, from this description, that this lamp is extremely simple in its construction; and indeed this great simplicity forms one of the most striking features in its construction: still, however, it is simplicity combined with utility in a truly scientific manner; and it accordingly requires that great attention be paid to its accurate construction, to make it succeed in use. We shall endeavour, therefore, to explain more fully, in detail, the necessary particulars to be attended to in its construction.

The body, A, is composed of a rim or ring of tinned iron-plate, bent into the shape shewn in fig. 3, and soldered together near E: before soldering it, however, the burner, C, must be fixed in its place: this burner is made of a piece of tinned iron-plate, of the form shewn in fig. 9; the edges of the four hollows around it being turned up at a right-angle; and then both sides bent at the two dotted lines across, so as, when brought together and soldered, to form a

flat tube with a long slit or mouth, and two side branches with apertures in each: holes must then be made in the rim to receive these branches, which must be firmly secured therein by soldering; great care being taken to leave the apertures quite smooth and open: and the top of the burner, C, must be made to project a little forwards, as shewn in fig. 4: the flat top and bottom of the body, A, are then to be soldered to the rim, by laying the rim first upon the bottom, and running solder all around the inside of it; and, after shaping the bottom to the rim by filing, the rim is to be laid upon the top, and secured to it by running the solder all around the outside of it.

The top of the burner, C, should rise about one-eighth of an inch only above the top of the box A. The wick-holder L, fig. 5 and 6, is a flat tube made of a piece of tinned iron-plate, bent into the shape shewn, and soldered along one edge, having two slits made through the front side of it to raise the wick up by means of a common pin: it must also have two springs formed below, by cutting the metal into the shape shewn; which, being bent outwardly, act against the inside of the burner C, and therein support the wick at the requisite heights. Two upright loops are soldered in the middle of the circular gap, near J, to receive the stems of the wire hook and ring, which supports the glass chimney at a proper height, as is usual in Argand lamps.

It will be seen, from the figures, that the conical hood, I, differs very considerably in shape from the common ones; being, in fact, only part of a cone, and that part thrown considerably forwards, by which means it reflects the light downwards, quite close to the base of the lamp.

The best wicks for this lamp are made of the ordinary wick-yarn loosely woven into tape; being, in fact, exactly such tape-wick as is made for the street lamps: this is much superior to the tape-wick made of hard spun cotton woven closely, because of its absorbent power in drawing up the oil: it should be waxed on the outside, by warming the end of a wax-candle over the flame of a candle, and rubbing the melted

wax over both sides of the wick; after which, it should be drawn slowly over a round smooth heated iron, such as the stem of a poker for instance, to diffuse the wax more equally through the wick, and to make it even and straight: it is then to be cut into pieces of an inch and three-quarters long; and the four corners of each piece must be cut off, as well to render them fitter for introducing into the wick-holder, as to prevent the formation of soot on the corners, which would otherwise take place. Each of these pieces of wick are fully sufficient to supply the lamp for a week in the long winter evenings; when they ought to be changed for new ones, as they would otherwise become so clogged up with the oil as not to draw well, and more especially when the common whale-oil, at two shillings and six-pence a gallon, is used, which is quite good enough for this lamp, and burns in it without the least smoke or smell.

The only trouble attending the management of this lamp, is, to fill the body A with oil every morning, till it just enters the bottom of the tube E, but does not rise in it (as, otherwise, it would be apt to overflow at the burner); to cut off the top of the wick even with the wick-holder, and then to raise it up with the points of the trimming scissars, about three-sixteenths of an inch; and, lastly, to cut each corner off: the lamp will thus burn for ten or twelve hours without needing to be touched, yielding a steady pleasant light, fully equal to the purposes of reading or writing; and at such an inconsiderable expense, and with so much convenience, that the Editor would scarcely be without it on any account.

This management of it, possibly, and the employment of the common whale-oil instead of the expensive sperm-oil recommended by the makers of it, may be due to the Editor; being the result of much experience, and of many experiments made with wicks in general: he therefore dwells more particularly on the necessity of employing the sort here described, where all the advantages of the lamp, in point of economy, are wished to be obtained.

It will be seen, that, in the construction of this lamp, every

facility is afforded to give the utmost freedom of access of air to the flame, so necessary to perfect combustion; there not being even a cup to the burner, to catch any oil which might overflow, as is usual in other lamps, to the great hindrance of the access of air: this, however, is here totally unnecessary, as the capillary attraction between the sides of the burner C, and the wick-holder L, is fully sufficient to prevent this, when the lamp has not been filled more than above directed. The oil, also, is placed in the most favourable situation for combustion: and it is highly necessary to attend to the directions above given, respecting the top of the burner C being not more than an eighth of an inch above the top of the body A; as one of the lamps purchased by the Editor, and originally intended to burn sperm-oil, would not burn whale-oil, until he had cut off the top of the burner to the above height, when it performed exceedingly well; and has now continued in use upward of two years, without its internal part having ever become clogged up, or requiring to be cleaned.

These seemingly minute particulars are the more necessary to be attended to, as all the success and good performance of the lamp entirely depend upon them.

It has already happened, most unfortunately for this lamp, that some attempts of a considerable lamp-manufacturer in this metropolis, to alter its construction, have entirely deprived it of its advantages, and brought it into discredit with the public. One of these changes consisted in the substitution of an upright tube, three inches long, instead of the burner C; and the supplying it with oil by means of an horizontal tube projecting from the middle of the circular gap B, and entering the back of the burner: he thus enabled it to hold a wick long enough to last for a month or two, without requiring to be changed; and, of course, to become clogged up with the oil, and hinder its free ascent to the wick: he also thus lost the advantages of supplying the burner with oil equally on each side of it; and entirely lost the opportunity of cleaning it, when neces-

sary, by the introduction of the feathered part of a quill into the mouth of the burner, and clearing it each way into the body of the lamp.

It is to be hoped that no one in future, in the hope of improving this excellent lamp, will venture upon any such innovations; and that the lamp, from the minute detail here given of its construction, will now come into that general use amongst us, which its great advantages, over most others, so eminently entitles it to do.

Mr. Parkinson, opposite to the Pantheon, Oxford-street, made the lamps used by the Editor, and indeed has made them for many years, for burning with spermaceti-oil; and Mr. Deville, of Exeter-House, in the Strand, has lately, by the Editor's advice, made and sold many of them; and has caused wicks to be made for them, which fully answer the purpose of burning with common oil.

A new wick should have its top first dipped into the oil, by putting it into the wick-holder contained in the burner; and be then reversed, and placed in its proper situation for use. A most convenient means of lighting it, or of obtaining a light from it, without taking off the glass chimney, is by the employment of the slender round waxed cotton, which is sold for the wicks of chamber-lamps, such as is used for the French floating night-lamps: this, cut into lengths of about five inches, ought to form a part of the furniture of every chimney-piece, in addition to the wax-bougies; as it kindles instantly, and the wax never drops, as it does frequently from the bougies: it is also equally convenient for lighting the Argand-lamps. Some of these are now made into oxygenated matches, for procuring light by dipping their prepared ends into sulphuric acid, as with the common oxygenated matches.

It should be observed, that, in the original lamp, Dr. Milner had made provisions for sliding the glass chimney-holder backwards, and forwards, and sideways; and also for moving the chimney upwards and downwards, in order to adjust the chimney accurately, in the best situation for

effecting the most perfect combustion of the oil. This was all very well for the philosopher, who would take the trouble to make these nice adjustments; but it also offered the means of easily deranging it; and, therefore, the substitution of the ordinary glass-holder is an improvement upon the original construction: and, indeed, when the best situation for the chimney is once found (which is easily done by a few trials, made by putting small pieces of wood upon the hook, of a greater or lesser breadth, for the chimney to rest upon, and to hold it higher or lower until the best effect is produced upon the flame), it is not now subject to be deranged, as at first.

An excellent lamp with two burners might be made upon this principle, by extending the body, A, sideways each way, and making it of an oval shape, to enable it to hold more oil; and forming another circular gap opposite to the one described, fitted up in the same manner. In this case, however, it would also be necessary to remove the supply tube, E, from behind to one side, in order to fill the lamp with oil more conveniently.

XXVIII.—*On the Allesoirs, or Boring Machines, &c.**

WITH A PLATE.

THE *Allesoir* is an instrument or machine used to enlarge, to make round or cylindrical, or to polish, the interior of the bodies or cylinders of pumps, steam-engines, hydraulic presses, fire-extinguishing engines, &c., the barrels of guns and pistols, the inside of the boxes of axle-trees, &c., and, generally, all round holes which continue their whole length of the same calibre. There are also conical *allesoirs*, to bore holes of that form; as the openings in cocks, &c.

In either case, the object to be bored being fixed in a vice or in any other manner, the *allesoir* performs its work

* From the *Dictionnaire Technologique.*

by turning, and at the same time advancing, on its axis; and by this double movement, it cuts and enlarges the hole in the metal in which it acts, until its calibre shall be of its own diameter.

This instrument varies in form and dimensions, according to the purposes for which it is intended. In the tool-shops they have small *allesoirs* or broaches of a half-round, triangular, quadrangular, and other forms, slightly conical; with handles, by which they may be held in the left-hand; or with heads, like wimbles or gimlets, by which they may be turned.

The chief use of these tools is, to round the holes; and the French workmen call them *équarrissoirs*, because they are most commonly square. The best are made of cast-steel, quenched in water and tempered till they become of a straw-colour. They cut better with fewer edges; for then they are sharper, but do not make the holes so round: these serve to rough-bore the holes; and they have others with six or eight edges, of the same calibre, with which they finish them. The best way of making these tools, whatever be the number of edges or surfaces they wish to give to them, is, to turn them first of the exact size they are intended to be, and afterwards to form their surfaces with a file; taking care that each edge, when rendered sharp, should exactly preserve the original surface of the cylinder or cone they were turned to.

The boring of iron, steel, copper, tin, lead, &c. is done with oil or water. Cast-iron is bored dry. The creaking noise in boring brass is prevented by the use of wax, which is also otherwise favourable to the operation. The *allesoirs* for gun-barrels are fixed in the end of a turning axle, placed either horizontally or vertically. This last position, though not generally used, is the most favourable for the work; because the borings fall, by their own weight, with more facility out of the barrel. Water is kept continually dropping on the gun-barrel to prevent its heating. In this operation, the gun-barrel is fastened in a sliding

carriage placed in the boring bench; and a counter-weight causes them to advance together on the *allesoir* or boring-bit.

The *allesoirs* for the bodies of small pumps are fixed on the arbor of a turning-lathe, having the double movement which we have just noticed. These are cut by a drill or drum; or, rather, with cast-iron discs or blocks, the circumferences of which are armed with steel cutters. The last polish is given by *allesoirs* or plugs of box or walnut-tree, whose surfaces are covered with emery or pulverized pumice-stone. They cause them to rub more or less hard, by introducing wedges of iron into a groove sawn longitudinally or lengthways in the centre of the *allesoir*. That the work may be perfect, the body of the pump, or the piece to be bored, ought to remain invariably in the position first given to it.

Steam-engines, cylindrical bellows, and hydraulic presses, being of the highest importance to our manufactures, and the boring of the bodies of these machines being the most essential parts of their construction, we will describe and engrave the machine which the English mechanicians now use for that purpose. To the best of our knowledge, there exist but two in France; one in the workshops of Chaillot*, and the other in those of MM. Cordier and Cazalis, at St. Quintin. The movement of these machines being uniformly continued, the result is, that the work is more quickly performed, and more perfect, than when done by

* There are in France, and particularly at Paris, says a French paper of a recent date, divers establishments for the construction of Steam Engines. Those of Perier and Brothers, at Chaillot, may be mentioned. These establishments, directed by an able English mechanician, are organized and conducted in such a manner as to supply annually a great number of steam-engines of the best construction, but always on the system of double pressure, so useful for the saving of fuel. They have at present on hand twenty-five engines of different dimensions and of various powers, from 40 to 100 horses. In the excellence of the system, and the perfection of the workmanship, the Journalist assures us, they do not yield to the best models of England. France therefore, which has hitherto resorted to England for these engines, can now supply herself from the fruits of her own industry, and the exercise of her own skill.

the old machines; where one was obliged to raise, from time to time, the weight which impelled the cylinder or the drill in the centre of its axis.

Description of the new Machine for boring the Bodies of Pumps &c.

Plate IV. *Figs.* 1 & 2. Plan and elevation of the machine. It is immoveably fixed, by means of iron bolts and screwed nuts, in a perfectly level position, on three solid stone or cast-iron blocks, X, Y, Z.

A, Horizontal axis carrying the cutters of the machine. It is of cast-iron, and must be turned truly cylindrical. A groove or channel, *a,b*, of one inch square, is made along half of its length. This piece, the most important part of the machine, is kept rectilinear whilst working, and must be let into collars.

B, Disc of cast-iron, fixed immoveably on the axis A; with its circumference armed with steel cutters, which perform the work of boring. These discs can be changed for others, suitable to calibres of any size. The cutters are always of an uneven number, in order that no two of them may ever be found diametrically opposite; and they are held in the gaps by iron wedges.

C, Puppets of cast-iron; which receive in the collars of their heads, furnished with brasses, the horizontal axis A, in which it must move freely.—See *fig.* 3.

D, Plane or bed of cast-iron; on the ends of which the two puppets CC are fixed perpendicularly, being formed of one piece with it. This plane is pierced with parallel mortice-holes, in order to place and fix, by means of bolts and screwed nuts, the supports which retain the body of a pump in a convenient situation for boring it.

E, Supports for the body of the pump. There are four; and each is formed of a plate which rests upon the plane D, and of another plane surface which is inclined

to the plate at an angle of 45°. As these two supports are placed contrariwise, the one to the right and the other to the left, so they form right angles; between which are placed both ends of the body of the pump, which is firmly secured with chains and screws. By varying the positions of these supports, we see they will admit the bodies of pumps of different diameters.—See *fig.* 4.

F, A large toothed-wheel of cast-iron; by means of which a rotatory movement is given to the axis A which carries the cutters, still preserving its faculty of moving in the direction of its length. For this purpose, the wheel is pierced in its centre with a cylindrical hole equal in diameter to the axis A: it carries a key of steel, which enters and slides freely in the groove *a*, *b*.

G, a plate of cast-iron, joined with screws to the prolonged piece D: it carries at right-angles to it, and at the right-hand side of it, the puppet H, which is elevated to the same level with the puppets CC.

I, a screw with a square head, fixed in the centre and at the end of the axis A.

J, a wheel with 23 teeth, fixed on the same end of the axis A, and turning with it.

K, a wheel with 25 teeth, driven by the former. On the right-hand side is seen a border, which serves to keep it in the same plane with the wheel J.

L, a round axis of iron, placed parallel with the screw I; and on this slides freely the wheel K: the whole being kept in a rotatory movement, by means of a key which enters into a groove made along this axis.

M, a wheel of 23 teeth, placed on the axis L, on the outside of the puppet H.

N, a wheel of 25 teeth, driven by the preceding wheel; and which carries the female screw of gun-metal, O, through which passes the screw I.

Fig. 3. Front view of the puppets C, placed on their blocks.

Fig. 4. View of the supports; with the means employed to hold the body of the pump in a firm position.

Fig. 5. Plan and profile of the disc carrying the cutters; shewing, on a larger scale, the means of fixing them.

From the various dispositions which we have described, it results, 1st, That the axis A, in turning, communicates its rotatory motion to the disc B carrying the cutters. 2dly, That it conveys the same movement to the screw I; which being engaged in the female screw O, would proceed with the velocity due to the rake of the screw, if the female screw remained at rest. 3dly, That this female screw, having, by the effect of the toothed wheels, J, K, M, and N, a movement in the same direction with the screw, moves slower, sixteen parts in the hundred, each revolution of the screw; and, consequently, the axis carrying the cutters advances horizontally, in a proportion equal to sixteen parts in the hundred of the rake of the screw. We must therefore calculate before-hand the time which it would take to bore the body of a pump of a given length.

M. F. E.

XXIX.—*On the Amadou, or Tinder Agaric**.

This is a spongy substance, of a very combustible nature, and used for obtaining fire with a flint and steel. The *amadou* is prepared from the tinder agaric (*Boletus igniarius*), a species of fungus, which grows at the roots of old oaks, elms, birch-trees, &c. Its substance is solid, compact, and in many parts ligneous. Its outer covering is a hard whitish bark; under which is found a spongy substance, rather moist, and soft to the touch, like velvet; all the lower part is ligneous. This agaric is common in large forests where the trees are allowed to grow old. It is gathered in the months of August and September.

The preparation of the agaric consists, first, in cutting

* From the *Dictionnaire Technologique.*

off the outward bark with a knife, when a fungous substance is found of a yellowish-brown colour. This last part is the only useful one; and care must be taken to separate it nicely from those ligneous substances which are under, and sometimes on its sides. The fungous part is cut into thin slices, and beat with a hammer to soften it: the beating is continued till the substance can be parted easily in pieces with the fingers. In this state the agaric is very useful for stopping hæmorrhages, and for other surgical purposes.

To make this into *amadou*, it is subjected to another preparation; which consists in boiling it in a strong lye of nitrate of potash: it is then allowed to dry, and again beaten; and afterwards placed a second time in the lye. For the purpose of causing it to ignite more instantaneously from the spark, it is rolled in gunpowder; which, alone, distinguishes the black from the reddish *amadou*. But to give to the agaric the property of lighting with the greatest facility, it is better to boil it in a solution of chlorate (oxymuriate) of potash, instead of nitrous lye.

Another kind of *amadou* may be procured by burning sugared paper, or bits of linen, till the flame is nearly out, and then instantly extinguishing it.

The puff-balls generally produced by plants of the genus *Lycoperdon*, which have for their base a fleshy filamentous substance, would form an *amadou*, if suffered to imbibe water slightly impregnated with gunpowder. For the same purpose they use in India a leguminous plant called *solu*, whose thick spongy stem, reduced to charcoal, takes fire like the *amadou*.

XXX.—**Cases illustrating the decided Efficacy of Cold Affusion in the Treatment of Poisoning from Opium†. By* SEPTIMUS WRAY, *Esq. Member of the Royal College of Surgeons, and of the Medical Societies of London, Montpelier, and Marseilles.*

CASE 1.—I was called, early in January 1821, to Mrs. E———, who had, half an hour before, taken about two ounces of laudanum. I found her in bed, in a state of profound stupor. Her pulse was much quicker than natural—her pupils were dilated. Every means which could be suggested at the time were employed to rouse her from her lethargy, but without effect. Under such circumstances, no internal remedies could be administered. I afterwards had recourse to cold affusion, which produced the most decided benefit. A large bucketful of cold spring-water was brought into the room, and a quart basinful was forcibly thrown on the head and chest. It roused her on the first application, but immediately afterwards she relapsed into the same state of stupor. By resorting repeatedly to the same means, in about ten minutes I had the satisfaction of hearing her speak. An emetic was then administered, which operated freely. Vinegar and water were given afterwards, and, on the least tendency to drowsiness, the cold affusion was repeated. I had the gratification, the following day, of seeing this lady perfectly restored.

CASE 2.—April 17, 1821. A gentleman, residing in the vicinity of Chancery-Lane, took two ounces and a half of laudanum, in a fit of desperation, on account of some losses he had sustained. Immediately after taking it he became sensible of his folly, and informed the waiter of the coffee-

* This and the following Article are taken from No. 103 of the London Medical Repository.

† This new, simple, and efficacious remedy was related to the London Medical Society, Jan. 29, 1821, in the presence of Drs. Clutterbuck, Walshman, Copland, &c. by Mr. Wray, the original discoverer of it. He has also found it efficacious in Apoplexy, when produced by fullness of the vessels in the head, without rupture.

house where he was at the time, of the circumstance, who immediately sent for a medical gentleman. An emetic was instantly administered, and after its slight operation he was put into a hackney-coach, and driven to Fleet-Street, where he had given his address. The coachman, on opening the door, found him lying at the bottom of the coach in a state of perfect stupor, from which he could not be roused. He was taken in this state to the watch-house, where he was recognised, and thence conveyed to his own house, when another medical man and myself were sent for. That gentleman having arrived some time before me, had employed the usual means, in order to rouse him from the state of coma into which he had sunk. Every attempt produced merely a momentary effect—when left alone, he dropped into his former condition. As soon as I arrived, I requested that the cold affusion to the head and chest might be tried. A few applications of it, in a similar manner as in the former case, had the effect of removing completely the profound stupor, and the other alarming symptoms which were present. He complained the following day of head-ache and soreness in the epigastric region; —the former arising, most probably, from the effects of the opium on the nervous system; the latter, from the irritation induced by the strong emetics administered in order to produce full vomiting. These symptoms soon yielded to bleeding and other antiphlogistic means.

CASE 3.—On the night of May 12, 1822, I was called to Mrs. W——, Whitefriars, an extremely delicate young woman, about twenty-five years of age, who, at half-past ten, had taken two ounces of laudanum, with the intention of destroying herself. Having been at that time particularly engaged, I sent my assistant, with directions to employ the cold affusion, and to administer an emetic, as soon as deglutition might be accomplished. If the symptoms were very alarming, he was also instructed to send for me. Immediately after his arrival, I was again sent for, at his request. On entering the room, he acquainted me that he

had considered it too late to do any thing, and, therefore, had not attempted it. She appeared, in fact, when I arrived, nearly dead. During the preparation for the cold affusion, I endeavoured to rouse her by various external means of irritation, but with no effect. The pupils were dilated, and quite insensible to the light from a candle that was presented close to them. The pulse could occasionally be felt in slight undulations, and the body possessed a considerable degree of warmth. The head and chest were raised; and I began by throwing a large basin-ful of cold water forcibly on the head, which produced an evident twitching in the muscles of the face. By repeating these means, at intervals of some seconds only, she uttered a lamentable scream, much resembling that of a person recovering from suspended animation by immersion. After a few more applications of the affusion, a very strong emetic was administered, with considerable difficulty; but it was no sooner taken, than she relapsed into the same state of inanimation, from which she was only restored by the frequent and forcible dashing of the cold water on the head and chest. She was afterwards raised from the bed, and carried up and down the room between two persons, with nothing on but a night-dress; and, by the repeated employment of the affusion, she might be said to have been in a continued shower-bath. In about half an hour from the exhibition of the emetic, it began to operate slightly. The ejected matters smelt strongly of laudanum. The vomiting was promoted by warm water and an additional emetic. After the stomach had been emptied, vinegar and water were freely administered. Notwithstanding these means had been used, she frequently relapsed into a state of syncope, from which she could only be roused by a fresh affusion. In about three hours from the commencement of the treatment, the pulse acquired greater force, and her appearance altogether showed an evident return of the powers of life. By constant attention, during six hours, to the means already employed, whenever they appeared

requisite, I had the satisfaction to see her sufficiently restored to allow her, with perfect safety, a few hours of repose. She only suffered a little from debility, during two or three days.

Remarks.—The first time my attention was drawn to the use of the cold affusion, in states of the system analogous to that which results from the immoderate ingestion of opium, was shortly before the occurrence of the case first related, when called to a patient in furious delirium, brought on by gin-drinking; and, as there was no possibility of taking away blood or administering internal remedies, I had recourse to the cold affusion, from a full conviction that the derangement was caused by a greater determination of arterial blood to the head, than could at once be carried to the veins, or returned by the lateral sinuses. Believing, also, that a continuation of this state will produce a distention of the capillary vessels in the brain, almost incompatible with life, owing to their delicate texture, and to the softness of the substance of the brain itself, I conceived the best plan to be employed was that which tends to prevent or overcome that distention.

From the well-known power that cold possesses of diminishing arterial action, and of producing constriction of vessels, I was led to its use in that case; and the effects which immediately followed its adoption exceeded my expectations.

The successful employment of the cold affusion in this case of extreme intoxication from a spirituous liquor, suggested its use in the treatment of poisoning from opium. The analogy between the one and the other I considered to be very close; the difference, in my opinion, consisting chiefly in the greater diffusibility of the latter agent, which would give rise to a more alarming degree of congestion of blood in the vessels of the head, after its primary effects had disappeared, than usually follows the ingurgitation of the former agent. The peculiar operation of opium upon the nervous system may also tend to produce

a very different effect to that arising from the diffusible stimulants, when taken in an inordinate dose. This specific influence of opium, as well as its more common operation, I consider to be altogether destroyed by the shock made upon the system by the cold affusion; and the extreme vessels become, in consequence of its constringing effects, roused to a healthy and tonic state of action. The event of the three foregoing cases sufficiently proves the efficacy of the cold affusion, in removing the noxious effects of this powerful agent. I have contented myself with giving an outline of their more prominent features. They are the only cases which have come under my observation since the mode of practice was suggested to my mind, in the manner I have mentioned; and, although they are few, still they are most important, from their uniformly successful issue. The last case more especially evinced the surprising effect of this remedial agent; for, to a superficial inspection, dissolution had apparently taken place before any means of restoration were employed.

XXXI.—*A Case of Poisoning by Opium, in which the Cold Affusion was successfully employed; with Observations on the Medical Management of similar Occurrences. By* James Copland, *M.D.* &c.*

August 26, 1821.—I was called, about half-past eleven at night, to Mrs. B——, a young widow, aged about twenty-four years, who had taken, about twenty minutes before ten, an ounce and a half of laudanum. Mr. Carroll, a very respectable practitioner in my vicinity, who had been sent for some time previously to my arrival, and who had requested that I should be called, had succeeded, with difficulty, in administering half a drachm of the sulphate of zinc. This, however, produced no effect. Five grains of the sulphate of copper were afterwards exhibited, which, when assisted by irritation of the fauces, caused a slight vomiting. I arrived at this time, and found the fol-

lowing symptoms very prominently marked:—her pupils were moderately dilated, and her pulse was 140, small, weak, and irregular. Her extremities, especially the hands and feet, were rather cold. She could with difficulty be roused, for a very short time, from a state of profound stupor; and when roused, the constant sighing which was present, and the other symptoms of oppression about the præcordia, sufficiently marked the inability of the heart fully to perform its functions.

I directed cold water to be dashed copiously, and with considerable force, upon her head. The first affusion roused her immediately, and so effectually, that she expressed herself, in answer to my inquiries, to be "relieved from the load and numbness which she felt in the brain." While observing the effect of the affusion, I noticed that a return of sensibility was introduced by a very deep sigh; and when the cold water fell upon the neck and chest, it was rendered somewhat convulsive.—Soon after she was thus effectually roused, copious vomiting spontaneously supervened—undoubtedly in consequence of the susceptibility of the system being awakened by the affusion, to the irritation of the emetics before exhibited. This was promoted until all ingesta were supposed to have been removed. Her pulse was still weak and quick, and occasionally irregular, but rather fuller than before. Two tea-spoonfuls of the following formula were ordered to be taken, in a cup of strong coffee, whenever the oppression at the præcordia and sighing were urgent—

℞ Spirit. Lavandulæ comp. ʒvj.
Liquoris Carbonatis Ammoniæ, ʒss. M.

The forcible affusion of cold water on the head was enjoined, as soon as stupor supervened, whilst the neck and chest were ordered to be wiped perfectly dry immediately afterwards, and the rest of the body to be kept dry and warm. She was also directed to be placed occasionally between two persons, and to be walked up and down the

room. At one o'clock in the morning I left her, in perfect confidence of finding a still greater progress towards recovery at my next visit.

I visited her again at seven o'clock on the morning of the 27th, accompanied by Mr. Carroll. The affusion had been resorted to thrice since I left her, owing to the supervention of stupor. It had the immediate effect of rousing her, for a considerable time, from her lethargic feeling, and of relieving her from the load she felt in her head.

The powerful stimulant prescribed at the former visit had also been taken three or four times.

At this visit, the pulse was about 100, and somewhat oppressed; there was no headache; the feet and hands were rather cold; considerable oppression was complained of at the region of the heart; and congestion of this organ was indicated by sensations of fullness and tightness in that part, accompanied by frequent sighing, and pain in the left shoulder and clavicle. Some pain was also felt in the stomach, which was a little increased by pressure—the result, most probably, of the irritation of the emetics. In order to relieve these symptoms, and more especially the accumulation of blood about the heart, a dose of the stimulating remedy already mentioned was ordered; and blood was directed to be taken from the arm, to the amount of eight ounces. This treatment was adopted with the intention of placing the moving power and the body to be moved, as nearly as possible, in due proportion. The detraction of blood produced slight syncope, which was soon removed by the recumbent posture. She afterwards felt much better; and complained merely of weakness, and of a slight pain about the left shoulder, which, however, was greater before the bleeding. The following draught was then prescribed:

℞ Mist. Camphorat. ʒx.
Magnes. Sulphatis, ʒjss.
——— Carbon. ʒss.
Spirit. Ammon. fœtid.
——— Lavend. comp. āā ʒss.
Syrup. Aurantii, ʒj. M.

Fiat haustus, ter die sumendus.

She was allowed four hours sleep after this visit; and afterwards, any article of diet for which she might evince an inclination.

I saw her again the following day (Tuesday the 28th) with Mr. Carroll. The aperient draughts had operated moderately. The pulse was much stronger and fuller. There was no headache, nor pain in any part. Indeed, with the exception of languor, she felt in her usual health.

Tonics, &c. were prescribed; and on the following day she was able to walk out.

XXXII.—*On an Alloy of Copper, Silver, and Platina.*—By DR. VAN ECKART.

This truly valuable compound metal was invented by Dr. Van Eckart, a German chemist, at Kingston in Jamaica; and was sent, in the year 1805, to the Society for the Encouragement of Arts, &c. &c., by its corresponding member for Jamaica, the late Dr. Dancer, with a description of its properties, but without any account of its composition; and, accordingly, a request was made by the Secretary, that such deficiency might be supplied. No answer, however, was returned to this application; and it is very unlikely now that it ever will be received.

Dr. Dancer says, that "he thinks it is likely to prove very advantageous in the Arts, from its great ductility and elasticity:—it is of the same specific gravity as silver, not subject to tarnish; can be drawn into the finest music-wire (for which it is very fit, on account of its sonorous property), from the size of one-eighth of an inch, without annealing; and does not lose its elasticity in annealing:—it will bear hammering red-hot, rolling, polishing, &c."

In the absence of all information on the subject of its composition, the Committee of Chemistry determined to submit it to analysis; and, accordingly, it was put into the hands of several persons: one of whom, Mr. Thomas Cock,

then with Messrs. Allen and Howard, chemists, of Plough-court, Lombard-Street, at the request of the Editor not only ascertained its composition, but also formed an alloy perfectly resembling it in all its valuable properties, and communicated the result of his success, together with specimens of the compound metal formed by him, to the Society: for which he received its thanks. But, notwithstanding this, from an overstrained degree of nicety, the Society, preferring to wait for that additional information which has never been received, have declined to publish Mr. Cock's analysis.

The Editor has repeatedly formed this valuable alloy for different persons: and as a large quantity of the crude platina is likely to arrive in this country from South America, and as he was the means of Mr. Cock's turning his attention to the subject, he is now determined to communicate the result of Mr. Cock's experiments, for the benefit of the public.

The following is the account of Mr. Cock's experiments on Dr. Van Eckart's metal:—18 grains of the compound metal dissolved in the nitric acid, left a residuum of 2.40 grains; which, dissolved in nitro-muriatic acid, and precipitated by muriate of ammonia, proved to be platina. A quantity of muriate of soda being added to the solution, threw down 4.07 grains of muriate of silver, equal to 3.53 grains of silver: and caustic potash being afterwards added, threw down 19 grains of oxide of copper, equal to 11.71 grains of copper.

Thus, 18 grains contain			100 grains contain
Silver	3.53	=	19.61
Copper	11.71	=	65.05
Platina	2.40	=	13.33
	17.64		97.99
Loss	.36	Loss	2.01
	18.00		100.00

16 ounces contain

Silver - -	3.03
Copper - -	10.40
Platina - -	2.13
Loss -	.44
	16.00

Or, quite near enough for practice,

	Ounces.
Silver - -	3¼
Copper - -	10½
Platina - -	2¼
	16 ounces.

The Editor, in the year 1806, made upwards of a pound weight of this alloy for Mr. Stansbury, who employed it with great success in the manufacture of the springs, plates, and other parts of his patent locks, on account of its not being liable to corrode by the action of the sea-air upon it. It was composed of the following metals:

Avoirdupois ounces.		oz. dwts.		£	s.	d.
3½	of fine silver = to	3 : 4	troy, at 6s. 3½d. ℔ oz.	1	0	2
12	sheet-copper, - - - -		at 2s. 6d. ℔ lb -	0	1	10½
2½	crude platina*, - - -		at 5s. ℔ oz. - -	0	12	6
18 ounces.	Melting 1s.; crucible & rolling 8d.			0	1	8
	Total cost of 18 ounces -			£1	16	2½

It yielded 17½ ounces avoirdupois of the compound. The metals were first melted together, under charcoal powder, in a covered crucible; but it was found necessary to add afterwards a little soap, arsenic, and borax, to render it perfectly malleable: when it worked exceedingly well, and was treated by the workman exactly in the manner of hard gold; and, like it, required frequent annealing, in first

* This should be freed from all the iron usually accompanying it, by the magnet. The scraps of malleable platina, which may be had at a moderate price, would, however, be preferable.

rolling and drawing it; but afterwards it worked very readily, and bore drawing into wire in the plates used for gold wire; which, the workman said, could not be done with any other metal, excepting gold, that he ever before met with.

XXXIII.—*On Instruments for Drilling and Boring.* *By the* EDITOR.

WITH A PLATE.

WE have given, in Article XXVIII. a description of a Machine for Boring Cylinders, and a general account of some other methods of widening round holes. In this and succeeding Articles we shall give a most minute detail of these important instruments. And, first,

OF THE CANNON BORING-BIT.

The Boring-Bit for Brass Cannon has, till within a very few years, been kept from the knowledge of the public. And although it has been used for many years in the Royal Cannon Foundery at Woolwich, and the Boring and Turning Machine itself was very frequently exhibited to persons viewing the arsenal; yet it was always so managed, that the Boring-Bits were most carefully concealed: hence, the Cannon Boring-Bit became an object of very considerable interest: its valuable effects, in boring perfectly straight and cylindrical holes of a considerable length, without the possibility of receiving any assistance from without, beyond the mere act of guiding and urging it forwards, were seen and acknowledged by many eminent mechanicians; but the means of accomplishing these effects remained a profound secret.

Even now, when the instrument (or rather a modification of it, in the half-round boring-bit,) is become of universal employment, the proper construction of it is known to very few indeed; possibly only to those immediately concerned in the making and using it in the arsenal.

This will not appear strange, from the following description of an instrument, which the Editor is enabled to give from a most extensive and valuable work by *Rinman*, the celebrated Engineer—published at the expense of the Government of Sweden, for the benefit of the pupils in the College of Mines—on the machines used there, and in other countries, in iron and copper works; and for which work, and its accompanying one, "*Nordwall's* Theory of Mechanics," the Editor is indebted to the friendship and kindness of the late celebrated Baron Edelcrantz, and of Mr. Gustavus Uhr, a Pupil of Nordwall's.

This instrument forms part of the apparatus used in the *English* horizontal bar-machine for boring cannon; and we are thus indebted to a foreigner for the first publication on a most valuable instrument long in use amongst us.

In Plate V. fig. 1, is a plan of the upper flat side of the Boring-Bit, of its proper size for boring the first holes in cannon from 12 to 24-pounders.

a b c d, Length and breadth of the bit; its under side being made semi-circular.

e e, Breadth of the bar which carries the bit.

f g h i, The cutter, sunk into the face of the bit: it is made of cast-steel, hardened and tempered; and is made to cut from *f g* to *g i*: it projects, beyond the semicircular back at *g*, one-sixteenth of the breadth of the bit, which is he thickness of its cut.

From *f h* to *h i* it is let into the face of the bit, as is shewn by the dotted lines.

k, is a small screw, with its head countersunk into the cutter, to secure it firmly in its place.

l, a concavity made in the end of the bit.

m, another small cavity sunk in the bit, to remove the cutter the more easily, when necessary.

Fig. 2, a section of the boring-bit.

a b c, a semi-circle, shewn by dotted lines: at *c* is shewn

the cutter, projecting beyond the solid half-round part of the bit, the extent of that semicircle.

d e, the steel cutter, let into the bit, which is undercut at *d*.

f g h i, the size of the bar carrying the bit; the angles *f g* touching the dotted line of the semicircle *a b c*.

k, the screw, shewn by dotted lines.

l, the concavity in the end of the bit.

It will be seen, from the latter figure, that the angles *f g* of the bar, constantly touching the bored cylindrical hole, keep the cutter at its work; and form two of the three points of bearing.

The dotted line from *h* to *e*, in this Figure, seems to indicate that the end of the bit is channelled spirally; with the intent, possibly, of facilitating the escape of the borings, which it is well-known are formed into a prolonged screw-like shape; and to this end the cavity *l* may possibly likewise contribute.

It may be necessary to add, that a hole the size of the bit must be previously made in the cannon by drilling, whereby to enter it.

OF THE HALF-ROUND BORING-BIT.

The construction of this valuable instrument, after the above description of the cannon boring-bit, will be readily understood, it being nearly the same in shape: nevertheless, there are points necessary to be attended to, and not by any means generally known, which very much conduce to its success in use. It is found by experience, that the bit should exceed a semicircle by one thirty-second part of a circle, to ensure its cutting smoothly. The proper degree of slope at its end is also an object of considerable importance: and, in particular, it ought to be carefully observed, that the angles of its stem or bar should touch the bore in the manner above shewn.

Its general shape may be learnt from the Figures before described; and, indeed, the more nearly it resembles

them, the better. It may therefore be merely necessary to state, that in this country the bits are generally made solid; and not with loose cutters, as there shewn: notwithstanding which, it would be a great improvement in them to have the power of forming and adapting the cutters in the manner there indicated.

The corners are not rounded off in general; which, however, would much improve the action of the bit.

In using these half-round bits, it should be observed that the cannon, or other articles to be bored, are kept continually turning upon centres during that operation; and that the bits are held or retained firmly, and prevented from turning, being merely urged forwards by means of screws. And also, that the object in using them is not so much to bore a large hole, as to make one *perfectly straight*; which is to be afterwards widened by other bits (the construction of which will be hereafter described), the first hole serving as the guide for the widening-bits.

[*To be continued.*]

XXXIV.—*Hints on Gardening.*

[Continued from Vol. I. p. 431.]

GARDENS DEFENDED FROM FLOODS.*

GARDENS which are situated adjoining to rivers subject to inundation, require to be defended by a wall, or a bank of earth protected by hurdles of wicker-work. The latter, however, may be protected, even from the powerful overflowing of the sea, by a simple process, which the writer saw most successfully practised at Cuxhaven, a watering-place at the mouth of the Elbe, where the bank afterwards afforded a most agreeable promenade.

This process consists in twisting straw into bands, and (with an iron pin ten inches long, curved inwards at the

* From *Abercrombie's Practical Gardener*, by permission.

bottom, and a wooden mallet) driving the straw-band six or eight inches into the bank, there to remain; then withdrawing the iron pin, and, at a distance of four inches, again driving in the straw; and so continuing to affix the straw into the bank and soil liable to inundation, in direct lines, till the whole surface be covered: thus forming a close and smooth piece of straw work.

It is adviseable to commence this business at that season of the year when the soil is tolerably dry, and the waters are at the lowest; not only for the convenience of the operation, but especially for sowing the grass seeds under and within the straw bands; as the grass soon springs up through the straw, and forms a beautiful turf; which, of itself afterwards becomes a natural barrier against the waters.

NEW METHOD OF STRAW-WORK, FOR FENCES, WEATHER-GUARDS, &c.*

Fences of straw may be formed of any width and length, by the following process. Provide a wooden platform of the desired width, from one to two yards, with a shallow ledge along its sides, to keep the straw within a regular boundary. Let the straw be a little damped, and drawn by the hands into straight lines, to be disposed across, and of any desired thickness, over the whole surface of the platform. When the straw is thus disposed, some loose bars of wood are laid across it, to keep it in place during the operation. Then proceed, with a curved sacking-needle and twine†, (commencing at one end of the platform, and at about two inches from the top,) to brace the straw within continued loops of the twine, in direct lines, from one end of the platform to the other; and knotting or tying the loops of the twine at distances of about two inches. The second and remaining lines of loops are made in like

* From *Abercrombie's Practical Gardener*, by permission.

† Or, which would be better, with two needles and two lines of twine. See the following Article.—EDITOR.

manner, about four inches apart, until the whole surface of the straw is thus braced and fastened. It is then rolled up, and placed on the right-hand side of the platform, for the purpose of uniting it with the second and continued process on the platform.

By this means any length of fence or weather-guard is obtained for horticultural purposes, (and the same is also useful for package of dry goods,) at a very small expense; which can be used as a covering, or as an upright fence with a few stakes; and readily rolled up and removed, without litter, and with very little trouble.

[*To be continued.*]

XXXV.—*New Method of Weaving Mats.* By MR. CHARLES SALISBURY.

THIS method consists in disposing in a cheap and coarse kind of loom, a double series of plain and coloured lines or longitudinal stripes of twine; the stripes being at intervals considerably apart from each other. These threads of twine being opened in the manner of a warp, by means of the treddles and harness of the loom, either Dutch rushes, or the leaves of the *Typha latifolia* or Greater Cats-tail*, torn into shreds, are to be introduced, from time to time, with a wooden needle, having an eye or opening at one end of it to receive the rushes, to form the shoot, and the twine is closed over them by the continued action of the loom.

In this manner a very cheap and useful matting is fabricated, the use of which is now become very considerable amongst us, although the invention is of a very recent date.

* For the formation of matting wholly made of the *Typha latifolia*, Mr. William Salisbury (father to the Mr. Salisbury mentioned as the inventor of this process,) was rewarded by the Society of Arts, &c. &c. with the Ceres Silver Medal of the Society. See Vol. I. p. 140.

XXXVI.—*On Iron and Steel.* *By the* EDITOR.

[Continued from Vol. I. p. 426.]

ON THE USE OF CHILLED CAST-IRON FOR PUNCHES AND OTHER TOOLS.

WE have, in our Article "On Reducing Friction in Machinery," stated the great advantages of substituting bearings made of *Chilled Cast-Iron*, in place of those made of brass. We shall now mention another most important application of it.

It is well known that, in making holes in red-hot iron articles, such for instance as wheel-tire, horse-shoes, &c. the hardened and tempered steel punches become softened from the effect of the heat; and, changing their shape, must be repaired from time to time.

Mr. Peter Keir, engineer, of St. Pancras, several years since having occasion to make many nail-holes in the wheel-tire of artillery carriages, and horse-shoes; and having experienced the above inconvenience in a very great degree, luckily bethought himself of substituting punches made of chilled cast-iron, for those of steel, and which he found fully to answer the purpose, as they constantly retained their original hardness, notwithstanding they very frequently became red-hot in using.

As, however, chilled cast-iron is not sufficiently tough to bear bending without breaking, he found it necessary to strengthen his punches, by surrounding and inclosing their stems in cast-iron holes, made of shapes corresponding with the stems, in properly shaped supports, and having their points only standing out a sufficient length for use.

ON FORMING CUTTING TOOLS OF CAST-STEEL AS HARD AND TOUGH AS POSSIBLE.

It is well known that the proper hardening heat for cast-steel is exceedingly difficult to be attained, and that a very little excess of heat is sufficient to deprive it of its most

valuable properties; hence, in order to obtain the edges or points of steel instruments of the greatest degree of strength for important purposes; such, for instance, as the edges of knives for dividing mathematical instruments,—Mr. Stancliffe, an excellent maker of those instruments, and formerly a workman of the late celebrated Mr. Ramsden's, adopted the following most excellent method:

After shaping the tool, and condensing it by hammering, he carefully heated the point and quenched it: he then, with the edge of a file, made trial by filing along from the soft and unhardened part, to that part of it where it became hard; and formed his cutting part or edge, by grinding and whetting that part to shape. He was thus assured of the quality of his tool being the best that the steel he employed could possibly produce; nor did it require tempering, as usual.

It is to be hoped that this valuable process, now for the first time published, will be adopted, wherever tools, possessing all the advantages in point of hardness and strength which steel can give them, are required.

[*To be continued.*]

XXXVII.—*On the Production of* Blue, *instead of* Red, Flowers, *in the* Hydrangea hortensis: *with some Notes on the Propagation and Management of the Plant. By Mr.* William Hedges, F.R.S. *Gardener to the Earl of Mansfield, at Kenwood.**

Soon after the first introduction of the *Hydrangea hortensis* from China into our gardens, some plants of it produced flowers of a blue, instead of a red colour. It was at first thought that the plants which thus differed from the original one, were a distinct variety; but as neither the same plants, nor those raised from them, continued to produce blue flowers, it was evident that the change was the effect of a peculiar culture, either accidentally or intentionally used.

* From the Transactions of the Horticultural Society.

Being much struck with the beauty of the flowers of the new colour, I became very desirous of producing the change myself, and made trial of the different methods which were recommended for the purpose.

It was at first generally given out, that either common salt or salt-petre used in small quantities, with ordinary loam, was the cause of the change: these I applied variously, but without success; and I believe it is now well understood, that neither of these ingredients at all contribute to make the colour of the flowers vary from red to blue.

Plants sent to Covent Garden for some years, by Mr. SMITH, of Dalston, and some which were sold by other gardeners in the vicinity of London, were known to bear very perfect blue flowers: these plants were shifted in the winter from the common compost in which they grew, into bog-earth; and the transition was successful in its operation. I accordingly removed plants into pots filled with the bog-earth of Hampstead Heath; but to my great mortification they still retained, when in flower, the original colour. I am, however, assured, that by shifting the plants from loam or compost, into the bog-earth used in the nurseries round London, they will blow blue; and I hear that Mr. SMITH still succeeds by this practice.

What I failed to effect by experiment, I at last obtained by accident; a hydrangea, which I had turned out into a particular border of the shrubbery at Kenwood, produced blue flowers two years successively. The soil which caused the plant thus to change, was a pure pale yellow loam, inclining to a light brick-earth, such as is used for pine-apple plants, and which is found in abundance on Hampstead Heath, from whence I have since taken it for the same purpose, with equal success; and Mr. MORGAN has informed me, that he has always made his hydrangeas produce blue flowers, by planting them in similar loam, from a common in the neighbourhood of North-Mimms Place, in Hertfordshire. I have also lately learned, that, in gardens and shrubberies, where the borders are of this sort of loam, the

hydrangeas, which are turned out into them, always blow blue.

Having thus attained my object, I continued to grow my hydrangeas, some with red, and some with blue flowers, according as I placed them in garden compost, or in the yellow loam of Hampstead Heath. If a plant whose flowers had been red one year, was shifted into the loam, they became blue; if the plant remained in the loam a second year, the flowers continued to be blue; but if it was returned to the garden compost, whether after one or two years, it resumed the red colour of its flowers. It was conjectured that a superabundance of iron in this loam might cause it to produce this change in the plants, and this conjecture was strengthened by an account that a small quantity of filings of iron or steel, mixed in any soil in which hydrangeas grew, would make them vary the colour of their flowers. To ascertain the accuracy of this account, I planted several hydrangeas in various soils, into which I put a small quantity of iron-filings; others I planted in bog-earth, others in garden compost, and some in the Hampstead-Heath loam; but I obtained blue flowers from the last only: I therefore place no reliance on the efficacy of steel- or iron-filings, nor do I suppose that iron can be the agent in the change, since mould which contains as much iron as that of Hampstead Heath, is useless for this particular purpose. It cannot be questioned but it is some peculiar quality in the earth which produces this singular effect; what it is, I have not been able to ascertain: all I can do is to give the results of my experiments, which are, that no adventitious matter, yet named, will effect the change with certainty; that garden mould or compost will invariably keep the flowers red; that some sorts of bog-earth will make the flowers blue, as is the case in the Dalston garden, but that every sort of bog-earth will not; and lastly, that the sort of yellow loam, I have described, will invariably produce the change.

Few plants exceed the *Hydrangea hortensis* in beauty,

especially if some bearing blue and some red flowers are mixed together. I have in general been very successful in the management of them, which has been conducted in the following manner.

As a succession of young plants is necessary, I raise some each year by taking, in the beginning or middle of July, young shoots with three or four joints, cutting them off close to the joint which is at the bottom of the shoot; these are planted in rich earth, in a warm border, and covered with a hand-glass; they are shaded during the middle of the day, and sprinkled with water from a fine rose watering pot, two or three times a week, in the evening, so as to keep them moist; the glass being kept close over them at all times. They will also grow by layers made in July, in the same way as is usual with carnations. The cuttings or layers will be well rooted by the end of August, at which time, or early in September, they must be put singly into small pots, and placed under a frame which at first must be shut up close; if they can be assisted by a temperate dung heat, at this time, it will be better for them. In the frame they must be shaded and watered as before. About the middle or end of October, they are to be taken into the green-house, or other shelter, where they can be protected from wet and frost; during the winter, they must be watered once a week or fortnight, as they may require. In the latter end of May, or early in June following, they must be turned out into a bed of rich mould in the open ground, to remain there till September, when they must be taken up and potted, and kept protected from damp and cold, as in the preceding winter. Instead of turning them out, as stated, in the spring, they may be retained in pots; but they must be shifted twice during the summer. By either method fine strong plants will be formed, fit for forcing, or turning out in the succeeding spring. If wanted for the borders, let them be put out when all danger of their sustaining injury by frost is over; they will stand the winter in the borders, and will also bear flowers, though not so

well as when protected by a house. Those which are to flower in pots, are taken as soon as their buds begin to swell in the spring; all the old mould being removed from their roots, they are planted in fresh earth, in pots of about eight inches diameter at top, and placed in front of the green-house or peach-house; if the plants are not over large, pots of smaller dimensions should be used; these will come into flower in June. Care must be taken to supply them plentifully with water whilst they are coming into bloom, and it is best to place water-pans under the pots, to secure a continual supply of moisture. If it is desired to have plants in flower *early* in the spring, they must be shifted into their new pots in January, and brought forward with forcing heat. The mould I generally give to my hydrangeas is a compost of loam and bog-earth, or leaf-mould with a little sand, well incorporated together; in this they will produce red flowers; if they are expected to blow blue, they must be planted in the pure yellow loam.

XXXVIII.—*On the Preparation of the Acetate of Mercury*[*]

Of this article two kinds are known in the laboratories; the base of the one is the protoxide, and of the other, the red oxide of mercury: the first is used in medicine under the name of *terra foliata mercurialis*. It is principally prepared by the direct combination of the protoxide of mercury with the acetic acid. This mixture is made to boil sufficiently, to saturate the acid, filtered, and evaporated; and on the cooling of the liquor, when sufficiently concentrated, the acetate of mercury is obtained, which crystallizes in small, thin, white, pearly scales. According to the process which we are about to describe, and which, in fact, is much more expeditious, we prefer preparing the *terra foliata mercurialis* by double decomposition. We take a

[*] From the *Dictionnaire Technologique*.

concentrated solution of proto-nitrate of mercury, and add to it a sufficient quantity of a very pure solution of acetate of soda. It immediately precipitates, and the scales or crystals will be the finer, as the solutions shall have been more concentrated. The whole is to be thrown on a filter to drain, and be frequently washed with a small quantity of cold water, and left to dry in a stove.

XXXIX.—*On the Manufacture of the Hydrochloric (Muriatic) Acid, in France**.

The Hydrochloric Acid is known in commerce by the names of Muriatic Acid, Marine Acid, Spirit of Salt, &c. The preparation of this acid on a large scale, in France, may be dated, from the first commencement of the manufacture of soda. When the application of the process of Le Blanc, for the conversion of the sulphate of soda into factitious soda, was made at the laboratory of M. Payen, he effected the decomposition of marine salt, by the sulphuric acid at 55°. in large leaden boilers (of 3 metres long, 1 metre 66 centimetres wide, and 34 centimetres deep), covered with sheets of lead, and luted. The acid gas which was disengaged, was conducted through, and circulated in, a channel of glazed bricks, of 600 metres in length, where it was condensed by a sheet of water of some millemetres in depth, which ran slowly, in a reverse direction to that of the gas, owing to a descent of five millemetres per metre. At that end of this channel nearest to the apparatus, it was perceived, that the hydrochloric acid was as much condensed as possible, and tolerably pure; and at the other end, the condensing water gradually diminished in density, containing very little acid. This condensing apparatus was then sufficiently perfect; but the decomposition of the marine salt

* From the *Dictionnaire Technologique*.

could not be finished in the leaden boilers: it was therefore found necessary to put it into a reverberatory furnace, to finish the decomposition. The loss by this means, was 50 centimes of hydrochloric acid. The great quantity of gas which was disengaged, during the time the leaden boilers were being emptied, suffocated the workmen; and those who could breathe it, were sometimes so strongly affected that they spit blood, and milk was administered to them, to preserve them from its action.

The employment of hydrochloric acid being at that time very inconsiderable, the loss which was sustained was of very little importance; and even lately, when they were obliged to manufacture soda, they neglected entirely the production of hydrochloric acid. They made use of the process called *des Bastringues*;—the gaseous product being thrown into vast subterranean places, where currents of water condensed it; by this means, the destruction of vegetation in the surrounding country was prevented—a thing which often happened before this precaution was adopted, when the fogs brought down on the earth the acid hydrochloric gas from the manufactories. At Marseilles, where the consumption of this acid is far from being proportional to the manufacture of soda, this process is employed; and till very recently, M. Chaptal, in the environs of Paris, continued his manufactory established on this plan. Lately, however, the use of the hydrochloric acid has been considerably extended: they now endeavour to obtain both products in the manufacture of soda; and the apparatus for obtaining it has been modified and changed in a variety of ways.

But it would be too long to describe here all the forms successively adopted. We shall therefore only speak of the two most important, which are still employed; and shall explain the motives why a preference should be given to a third method of manufacture, which we shall afterwards describe.

DESCRIPTION OF THE APPARATUS "DES BASTRINQUES."

At the end of a soda furnace, called a reverberatory furnace, a leaden basin of 33 centimetres in depth, and as wide as the interior of the furnace (1 metre 66 cents), and of two metres in length, is encased in brick-work, so that the upper edges, covered with plates of cast-iron, are on a level with the passage of the flame issuing from the furnace; the vault of brick-work which covers the basin is made similar to that of the reverberatory furnace, and is of the same height; the flame which escapes from the furnace enters the vault, over the surface of the cast-iron plates, by a passage of eleven centimetres in height: it returns upon itself; and, passing through a space made under the bottom of the basin, it is divided in two, to be conducted into the chimney by two lateral channels. This boiler, or basin, is thus set, that all its parts shall be enveloped in the channels which convey the heat coming from the soda furnace, and this is thus a secondary employment of that heat. A door is made to open in the end of the basin, in order to charge it with marine salt,—(a charge is generally composed of 12 sacks of 100 kil. each, or 1200 kil.)—and is afterwards luted as closely as possible; and they pour in sulphuric acid not concentrated, (that is to say at 54° of Beaumé, equivalent to $\frac{57}{100}$ of dry acid; and they use 110 of this acid for 100 of salt), by an opening made in the higher part of the basin. Decomposition ensues, and the hydrochloric acid gas mixed with the vapour of water is disengaged, and passes through four earthen tubes, into the refrigeratories, where it is condensed. These refrigeratories are composed of large earthen bottles, placed upright, one above another, to the number of seven or eight in each set; and inverted, or with the neck of the one, entering the bottom of the other: the gas passes through the whole, from the highest to the lowest; and must be condensed, before it arrives at the last.

The acid flows from the bottom, and fills in succession, the

bottles, in which it is sent to market. When the operation is finished, they open the door in the basin, and allow the residue to run off in the form of a fluid paste, upon a square of brick-work, on the exterior of the furnace. This residue soon becomes hard in cooling, and is broken into pieces for the manufacture of soda. The great quantity of gas which is disengaged during the withdrawing of this mixture, renders this period of the operation the most painful to the workmen. Thus, as we have before said, this operation is very imperfect, especially if we would also obtain the hydrochloric acid. The difficulty of perfectly luting the plates of cast-iron which cover the basin; the impossibility of finishing the decomposition of this salt, since the residuum must remain in a liquid state; and, finally, the loss sustained by the melting and alteration in the form of the lead, &c.; are such, that we can never obtain more than from 80 to 90 of the hydrochloric acid at 21° of Beaumé, or 1170° of specific gravity, equivalent to 25 of real acid, for 100 of the salt employed. This is not two-thirds of what might be obtained.

The second apparatus which was employed, and which indeed the manufacturers still use, consists of a gallery, containing 15 or 20 boilers of cast-iron, of 66 centimetres in diameter, and 40 centimetres deep, covered with discs of lead, which are luted, and fixed to the rim of each boiler, by a cap, secured with iron screws or wedges. The marine salt is then introduced, and the covers luted; and a communication is established, by means of a curved tube, between each of these boilers, and a series of seven or eight earthen bottles, with two tubulures, half filled with water; and which communicate with each other by means of double curved tubes. They pour sulphuric acid at 66°, by means of a funnel, into an opening made in each leaden cover; and heat them by little and little, augmenting the fire gradually, until all the gas being disengaged, the bottom of the boilers become of a cherry red. The acid of the two or three last bottles being considerably too weak, they finish the saturation of the gas, by

placing these bottles in the first row, in each succeeding operation. It is useless to give a longer detail of this process, which presents so many inconveniences, that it ought to be abandoned. One of the greatest, is the difficulty of detaching the masses of sulphate of soda, which are firmly affixed to the bottoms of the boilers. The fuel, the labour, and the destruction of the vessels; render this process more expensive, than the mode of manufacture, which we shall now describe.

DESCRIPTION OF THE APPARATUS NAMED "THE CYLINDERS."

We will suppose a furnace constructed for 20 cylinders, of the following dimensions: 1 metre 65 centimetres long, 50 centimetres in diameter, and 3 centimetres thick; the cast-iron they are formed of, must be very homogeneous, and their thickness uniform, in order to avoid the unequal dilations which the cast-iron is liable to. Although the same furnace contains twenty cylinders, yet they are separated into pairs, each with its vault and fire-place. It is necessary that all the parts of these cylinders should be equally heated, in order that the decomposition of the salt should take place simultaneously, and that the acids should corrode them less. (The cast-iron is also less attacked when it is at the hottest, and the sulphuric acid contains less water.)

Most of the manufacturers, with a view of saving fuel, by the construction of their furnaces, oppose the passage of the flame by many contrivances, and cause it to circulate around the exterior of the cylinders. This system is bad, and does not afford the economy sought after: because the narrow passages slacken the draught, they are soon choked by the smoke which is condensed therein, and which would be usefully burnt in a freer space: the decomposition is unequally effected, and less perfect; and the cylinders are more strongly corroded. It is, then, very important that the heat should be general, equally diffused, and quite at liberty. To effect this, the naked body of the cylinder ought to be enveloped in the flame. It is

well, lastly, to make it circulate underneath the arch, to cause it to give out a part of its caloric, before it escapes by the chimney.

Each cylinder is closed at both ends by a disc of cast-iron, of 3 centimetres in thickness, and of the diameter of the interior of the cylinder: it enters within it, and is supported on a small circular border or rim. These discs have on their outside a cast-iron handle, which is well fitted, and small pieces of pipe, inclined from without to within, and placed on the highest part, by which to introduce the acid at one side; and on the other, to adapt the tube of glass or earth which leads to the condenser: (the same inclination is requisite to both pipes, that at one end the sulphuric acid may be easily introduced, and at the other, that less sulphuric acid should pass into the receivers during the distillation). The first cylinder communicates by a bent tube with a high earthen vessel, which has two tubulures; the second tubulure of which conveys, by a tube likewise bent, the gas which is not condensed into another similar vessel. This second vessel also receives the gas disengaged from the second cylinder and conveys, by a third tubulure and curved tube, the gas not condensed in the two first, into a third; which also receives the gas disengaged from the third cylinder; and so on to the last vessel; which, receiving the gas from all the others, as well as all that which is disengaged from the last cylinder, conveys all the gas which is not condensed into a second range of the same number of vessels (twenty), where it passes successively from one to the other, until it is entirely condensed.

It is necessary that the first range of bottles should be entirely plunged into water, which is slowly renewed by entering at the lower part of the basin which contains it, at that end where the last vessel is placed; and passes off heated at the other end, from the higher part of the said reservoir. It is in the second range of vessels that the purest hydrochloric acid is collected; that condensed in the first,

always contains a small quantity of sulphuric acid, and sometimes of sulphate of soda and muriate of iron. All these bottles should be half-filled with pure water, which will absorb $\frac{3}{7}$ of its weight of muriatic acid gas.

This condensing apparatus is but little known, although greatly preferable to many of those commonly used in laboratories; and it is neither more expensive, nor more difficult to manage: it likewise affords more acid, and the acid is purer. They obtain by it from 100 of marine salt, 130 of hydrochloric acid at 23° of Beaumé, or 1190° of specific gravity, equivalent to $\frac{39}{100}$ or nearly 39 of real acid; the marine salt, as prepared by the makers of it, in consequence of the water and other foreign matter, contains only $\frac{92}{100}$ of pure salt; which, according to the calculation of $\frac{46}{100}$ of real acid, is equivalent to 43:—now they obtain 39. It is scarcely possible, in the large, to operate more accurately. All being thus disposed, it remains to be shewn that they charge the cylinders with marine salt (80 kil. in each); they lute with clay the stopper, or cast-iron disc; they light the fire, and pour in sulphuric acid at 66° in the proportion of 80 for 100 of the salt; and if the sulphuric acid at 64° is employed, it is less expensive in its concentration, and decomposes the salt better; it requires 83.25 of this acid, for 100 of marine salt.

A brisk fire should be kindled, but slackened as soon as the distillation begins; it is to be continued moderate, until the disengagement abates; the heat is then to be a little raised, to finish the decomposition. They unlute the opening to remove the sulphate of soda, and begin another operation. This sulphate should be white, uniform, and should not present, on breaking, any marine salt not decomposed; and yield from 208 to 210 for 100 of crystallized sulphate of soda. They draw off by means of glass syphons all the hydrochloric acid at 25°, into large earthen bottles, containing 60 litres; these are packed in wicker baskets with straw. It is in this state that it is generally delivered to the merchant.

[*To be continued.*]

XL.—LIST OF PATENTS FOR NEW INVENTIONS,

which have passed the Great Seal, since June 26, 1822.

To Marc Isambard Brunel, of Chelsea, in the county of Middlesex, Engineer; for certain improvements in Steam Engines. Dated June 26, 1822.—To be specified in six months.

To Thomas Gauntlett, of Bath, in the county of Somerset, Surgeons' Instrument Maker; for certain improvements in Vapour Baths, by which the heat is better regulated, and the baths rendered more portable. Dated June 26, 1822.—In two months.

To William Brunton, of Birmingham, in the county of Warwick, Engineer; for certain improvements upon Fire-Grates, and the means of introducing Coal therein. Dated June 26, 1822.—In six months.

To Louis Bernard Rabaut, of Skinner-street, Snow-Hill, in the city of London, Gent.; for an improved apparatus for the preparation of Coffee or Tea. Dated June 26, 1822.—In six months.

To Thomas Postans, of Charles-street, in the parish of St. James, Gentleman; and William Jeakes, of Great Russel-street, Bloomsbury, Ironmonger; for an improvement on Cooking Apparatus. Dated June 26, 1822.—In two months.

To George Smart, of Pedlar's Acre, Lambeth, in the County of Surrey, Civil Engineer; for an improvement in the Manufacture of Chains, which he denominates Mathematical Chains. Dated July 4, 1822.—In six months.

To Joseph Smith, of Sheffield, in the county of York, Book-keeper; for an improvement of, or in, the Steam-Engine Boiler. Dated July 4, 1822.—In six months.

To John Bold, of West-street, Nelson-street, Long Lane, Bermondsey, Printer; for certain improvements in Printing. Dated July 4, 1822.—In six months.

THE

TECHNICAL REPOSITORY.

XLI. *On Instruments for Drilling and Boring.* By the EDITOR.

[Continued from p. 128.]

WITH A PLATE.

THE HALF ROUND DRILL.

THIS instrument is shewn in fig. 1, Plate VI., and is found exceedingly useful in drilling holes in horn, tortoiseshell, or other similar materials. Its shape will be readily understood from the three views, (viz. front, side, and end,) which are given of it; being half round, with a rounded or hemispherical end. It is by no means generally known or in use, though highly deserving of becoming so.

THE DRILL FOR STEEL.

We are sorry not to have it in our power, on account of the hardness of the material to be drilled, to give a better form for the small drill for steel than that shewn, in front and sideways, in fig. 2, Plate VI.; such, however, is the case;—luckily, it is a form easily given, and renewed when worn, as it continually is in use, by whetting upon the Turkey oil-stone. It has merely two slightly-rounded edges; and the steel for the drill must be cast-steel, of a good quality, and made as hard as may be by hammer-hardening, hardening at as low a heat as possible, and tempering it only to a pale-yellow colour.

THE DRILLS FOR BRASS.

Here is, indeed, great room for improvement. The common form is given in fig. 3, Plate VI.; but it is only

shewn there that it may be avoided, and a better used in its stead. It will be seen that its end is whetted on both edges; and, the other face of it being shaped in a similar manner, the consequence is, that it merely scrapes, not cuts, the brass, and requires considerable force and pressure to make it even act at all.

In fig. 4, Plate VI. is shewn a better form, for which the Editor was indebted to the late Mr. William Troughton, a favourite nephew of Mr. Troughton the celebrated astronomical-instrument-maker: he was an excellent workman, and his early death is, indeed, a great loss to science. It will be seen, that in this drill, one edge of each face only is whetted sharp; and, consequently, that it only cuts in turning in one direction, namely, that in which it is pulled by the hand of the workman, in drawing the drill-bow towards him: nevertheless, it cuts so fast, and so easily, as fully to make amends for its not cutting when pushed from him. The point of this drill is made quite sharp, and each corner of its edge is a little rounded off, in finishing the whetting upon the oil-stone, which is very readily done by a little practice; and the effect of it is, to cause it to drill holes, the insides of which are beautifully polished. For the lathe, where the drill is constantly turned in one direction only, this drill is most admirably adapted; and we cannot too much recommend its universal application to the drilling of brass in general.

THE DRILL FOR HARD WOOD.

This excellent drill is shewn in fig. 5, Plate VI. and is formed upon the very same principles as that for brass, just described; its sides being however still more rounded off. This tool is mounted to a handle, and is held upon the lathe-rest in use; the wood to be drilled being at the same time held in, and turned by the lathe.

THE DRILL FOR CAST-IRON.

This instrument is necessarily made strong, in order to withstand the pressure made upon it to cause it to act.

Fig. 6, in Plate VI. will afford an idea of its shape, when viewed in front and endways; it is, however, usually made thicker at its end than is absolutely necessary; and the *obtuse angle*, formed across its point, is a very considerable hinderance to its progress. This may be remedied by making it thinner at the point; not, however, so much so as in the drills for brass, as that would weaken it too much: or, which is still better, its edges may be hollowed with a small round file (as shewn on the left side of the figure representing the front view of this drill), so as to make them cut better; and the hollows must also be carried across the end, as well as along the edges; thus giving it somewhat of a screw-like form.

DRILLS MADE OF STEEL-WIRE.

It is a very great convenience to make drills of steel-wire, on account of doing away the necessity of reducing the shanks by filing, as usual; all that is necessary here being, to spread the end by hammering, to shape the point, and to harden and temper it for use.

These wire-drills, however, require drill-stocks to be made suitable to hold them in. We shall describe one invented by the late Mr. William Allen, an excellent workman in ivory, tortoiseshell, &c.: and who, in ornamenting boxes, and other articles made thereof, required the aid of many different-sized drills, particularly in the cyphers, &c. done in gold-wire; where the swelling and diminishing of the strokes were produced by the varying thickness of the wire; and, consequently, required corresponding holes to be drilled to receive them.

MR. ALLEN'S STOCK FOR WIRE-DRILLS.

The basis of this stock is a tube of sheet-iron, soldered with speltar-solder, (see Plate VI. fig. 7), into one end of which a steel plug is soldered, having a point at its end, for common drilling with the bow; or a loop through it, for the string of a pump-drill to pass through. Into its other end, a steel tube is soldered, having a hole drilled

through it, as large as the thickest wire intended to be held in it; the nose of it has a taper screw made upon it, and two slits sawn across it, at right angles to each other, as wide at least as the diameter of the hole, and extending beyond the screw, (as shewn in the figure,) nearly to that part of the tube which is soldered into the iron tube. The four angular edges, which are thus formed by the cross-slits, must be left as sharp as may be, to penetrate and hold the soft steel wires the better: that part of the steel tube beyond the screw is to be filed square, as well to give it the property of yielding or springing, as to enable it to be held in the wrench or spanner, fig. 8; and the hole in it beyond the screw may be widened. It is then to be hardened, and the square part tempered to a spring temper; the screwed part must, however, be left as hard as may be, and it must be soldered into the iron tube with soft solder. To this screw two screwed nuts with taper holes (one of which is shewn in fig. 7), corresponding with the screw, must be fitted—the hole in one of them being smaller than that in the other—to the end, that it may cause the screw to bind the smaller-sized wires the better, when screwed upon the nose of the screw. Another wrench, fig. 9, must also be provided, having a taper hole in it, to fit upon the nuts. This stock is thus capable of receiving within its tube, and holding firmly, steel-wire drills, from the size of a knitting-needle down to that of a small sewing-needle; and, as each drill may be pointed at both ends, so a great variety of sizes may be readily made.

In order to put in or take out a drill, the spanner, fig. 8, must be placed on the square part next the screw, and the wrench, fig. 9, upon either of the nuts; and a power is thus obtained of either fastening the drills in the stock, or removing them with great convenience.

In fig. 7, a leaden or pewter ball, or weight, is represented by dotted lines, which is to be used when the stock is wanted for a pump-drill; but for a common drill, instead of the weight, a whorl of hard wood, with different-sized grooves

in it, as shewn by dotted lines, must be employed: and, to prevent it from turning round upon the tube, two pieces of sheet-iron, bent at right angles, must be soldered upon the tube, to form a square to fix the whorl upon.

A similar apparatus may also be screwed into the nose of a lathe with a hollow mandrel, to hold wire-drills in, with very great convenience. Mr. Stone has affixed a brace-head to this stock, which renders a breast-plate unnecessary. In drilling deep holes, this stock will be found highly serviceable, as no more of the stem of the drill need project than is necessary; and it may be lengthened by degrees, as the hole is made deeper.

It may be proper to add, that Mr. Lowry, and some other engravers, have long used a handle for holding etching-points in, *made of brass*, very similar to the above in form; but entirely without that great advantage of penetrating into and holding the steel securely, which one *made of hard steel*, and with sharp edges, possesses.

Figs. 10 & 11 represent two steel-wire drills, such as this stock is calculated to hold, as well as all sizes between them.

ANOTHER STOCK FOR DRILLS, INVENTED BY THE EDITOR.

The advantage of this stock consists in the great ease with which drills may be fitted into it. Fig. 12 of Plate VI. represents a side, end, and front view of the nose of the stock. This has a cylindrical hole drilled in it, of the size the stems of the drills are to be made of; and which, if made of steel-wire of that size, require no other preparation to fit them securely in the stock, than merely to file a flat slope or taper on one side of them, as represented in figs. 13 and 14. This slope acts against a taper steel pin, driven across, through a taper hole made in the nose of the stock, and thus securely wedges the drill tight in its place.

In case, however, of having to form the shanks or stems of the drills of larger-sized steel; in order to secure their uniformity of shape, the steel pin is made to take out, and the end of the nose of the stock is serrated or cut into

teeth, thus forming it into a rimer; which, on being turned round, upon the stem of the drill (previously made nearly to shape), will form it into a cylinder, of the exact size to fill the bore of the stock. A notch or gap is made in the stock, to introduce a proper instrument to act against the end of the stem, to drive out the drill, when necessary; and both the end of the stock and the steel pin must be hardened, and tempered to a proper degree.

It is quite evident that this stock is applicable to all kinds of drills, whether for common drills, pump-drills, or for the lathe.

A short notice of this drill-stock has been published in Rees's New Encyclopedia, as the invention of the Editor; but without the provisions for shaping the stems of the drills.

[*To be continued.*]

XLII.—*On the Manufacture of the Hydrochloric (Muriatic) Acid, in France.*

[Concluded from p. 143.]

Characters.—The liquid hydrochloric acid is white; that of commerce is of an amber colour, similar to the colour of brandy: it diffuses in the open air whitish vapours, strongly acid, which provoke to coughing: thrown upon the carbonate of lime, or upon other carbonates, it produces a lively effervescence; when it is too weak sensibly to disengage these vapours, its presence is distinctly shewn under the form of white vapours, by presenting to it a little ammonia on a glass stopple or other body. The hydrochloric acid is distinguished from other acids, even when diluted with a large quantity of water, by adding a solution of nitrate of silver, which it decomposes, and forms a white insoluble precipitate of hydrochlorate of silver. The quantity of real acid contained in the water is demonstrated by the saturation of the subcarbonate of soda. The pure hydrochloric acid is composed of one volume of chlorine, and one volume of hydrogen.

Uses.—The employment of the hydrochloric acid has

considerably augmented, especially since the recent use of the sulphuric acid in the manufacture of chlorine. It serves to clean metals, to prepare the hydrochlorate of tin, and to extract the gelatine from bones in glue-making. When united with the nitric acid, it forms the hydrochloronitric acid, or *aqua regia*, which serves to dissolve gold, platina, &c. We explain what passes in this operation, by supposing that the marine salt was in the state of a muriate, or hydrochlorate of soda; that the sulphuric acid seizes the soda, and disengages the muriatic or hydrochloric acid. This mode of explanation accounts for nearly all the phenomena, as well those now generally adopted, as those we are about to indicate.

Theory.—The affinity of the sulphuric acid to the soda (oxide of sodium) is greater than that of the chlorine in the marine salt, or chlorate of sodium; and, as their result is the sulphate of the oxide of sodium (sulphate of soda), the water must be decomposed; its oxygen unites with the sodium, whilst its hydrogen acidifies the chlorine, and forms the hydrochloric acid; which is disengaged in a gaseous form as soon as it is freed, by the combination of the sulphuric acid with the soda. Although this action may take place in the cold, it is rendered much more lively by heat; the water also favours it greatly, by augmenting the points of contact. It requires a very high temperature to drive away the last portions of sulphuric acid towards the end of the operation.

R.

XLIII.—*On the Geneva Lamps and Reflectors.* *By the* EDITOR.

WITH A PLATE.

WE promised, in our First Volume, p. 4, to give our readers some information on the lamps and reflectors employed in lighting the streets of Geneva so late as the year 1816, from particulars furnished us by Mr. Bruguier; and we

have accordingly caused an engraving to be made of them, on a scale of one half their real size.

Plate VII. fig. 1, is a perspective view of the lamp and reflector; and fig. 2, a section of the oil reservoir, valve, air-pipe, and the adjutage, or opening to supply it with oil; drawn to the same scale as fig. 1, but in a reversed situation, sideways. In both these figures, as well as in the other smaller ones, the same letters of reference indicate the same parts.——*a, a,* is the ring reservoir, to contain the oil; it is five inches and one-third part of an inch in diameter, and one inch and five lines in depth, having an opening in its centre of three inches in diameter.—*b,* the tube down which the oil descends. This should be three and a half lines (or twelfth parts of the French inch) in diameter inside, and long enough to extend downwards a little below the dotted line *c, c,* or the level of the oil in the burner.——*d, d,* is the air-tube, to supply air in proportion to the descent of the oil. This should be one and a half line inside diameter, and one line shorter than the tube *b,* from the bottom of the reservoir, so as to reach exactly to the dotted line *c, c,*; this air-tube reaches a little above the top of the oil reservoir, and is covered with a spherical cap, closely soldered to the top of the reservoir, as shewn at *e,* in fig. 2.——*f,* a conical plug, which closes the hole in the adjutage, through which, when the reservoir is inverted, the oil is poured to fill it: this plug is secured in its place by a cover, which screws upon the outside of the adjutage.——*g* is a conical valve, the stem of which moves in guide-holes; and its lower end comes into contact with the step *h,* in the body of the lamp (see fig. 1); when it is fixed in its place, and opens the valve to permit the oil to flow.——*i, i,* a circular ring, which rests upon the top of the dish-reflector, *k, k,* and has a rim all round it, for the reservoir *b, b,* to lodge upon.——*l,* a circular aperture in the middle of the dish-reflector *k, k,*—— *m, m,* hooks affixed to the reflector, to hang it and the lamp by, in the lantern.——*n, n,* pins, passing through holes in loops, affixed to the body of the lamp, *o, o,* whereby it is secured

to the reflector *k*, *k*,——*o*, *o*, the body of the lamp, having two hollow sides or wings, and a conical burner, *p*, in the middle of them, which has a cylindrical air-tube, *q*, in its centre, passing through the bottom of the burner, *p*, of six lines in diameter. Upon this air-tube and between another tube the cylindrical wick-holder, *r*, slides up and down, being moved by means of its handle, *s*; and it, and the outer tube, are so constructed as to permit the oil to penetrate easily to the wick.——*t*, an iron standard, soldered to the body of the lamp; having a ring above at *u*, and a hook, *v*, below, to support the glass tube, *w*, *w*, in a proper situation to procure a perfect combustion of the oil: this glass tube should be one inch and one-third in diameter, and nearly five and a half inches long.

Fig. 3, is a plan of the ring reservoir *a*, *a*, on a scale of one quarter its real size; fig. 4, a plan of the body of the lamp, on the same scale; and fig. 5, an elevation of the lamp and reflector in its lantern, *x*,—*y*, is the ring whereby it is suspended to the centre of a line or rope, extending across the street.

From this description, it will be seen that this is an Argand lamp, or one with a cylindrical wick, and a double current of air, calculated to burn common oil; and furnished with a circular or dish-reflector, well adapted to diffuse the light all round it; and which is formed exactly upon the principles described by Mr. Nicolas Paul, in his patent for lamps and reflectors, published in our First Volume; and, in fact, very nearly resembling that shewn in fig. 4 of Plate II. And, what is singular, it is formed nearly according to a plan sketched out for Mr. Paul, by Dr. Alexander Tilloch, in the year 1803; with this difference, however, that Dr. Tilloch's plan was adapted to one of Mr. Paul's burners with a flat wick, and currents of air on each side of it, instead of being fitted up, as this is, with a circular wick. And, in place of the conical adjutage *f*, to supply the ring reservoir with oil, and the valve, *g*, it had a stop-cock and funnel above the reservoir, and a tube descending from it, with another stop-cock below, which

answered the same purpose, and the air-tube was on the opposite side of the reservoir. What is yet more remarkable, an Argand lamp with a ring reservoir above, and two stop-cocks and a tube on one side, and an air-tube on the other, has been very recently constructed in this metropolis, by a manufacturer, without the slightest probability of his being previously acquainted with these particulars. This forms a table-lamp, capable of being rendered highly ornamental, and well deserving of universal adoption.

It will be seen, on a reference to fig. 1, of Plate VII. that the outer current of air is directed by the sloping or conical form given to the outside of the burner, *p*, to the middle of the flame; which, no doubt, is a considerable improvement in this lamp. It should be observed, that a hole must be made through the circular reflector at *x*, to permit the oil and air-tubes to pass through and enter the body of the lamp.

It should also be observed, that, when the reservoir is supplied with oil, and the cover of the conical plug is screwed down securely, before reversing it, to put it into the lamp, the conical valve should be brought home to its seat, in order to prevent the escape of any oil, previous to the stem of the valve coming into contact with the step, *h*, in the body of the lamp, which opens it again.

It is deserving of remark, that the best gas-burners on the Argand principle, which we have seen, are furnished with cones around the circular ring of holes through which the gas passes, and just below them; and which, no doubt, serve to direct the outward air upon the flames, in a similar manner to the conical body of the Geneva lamp.

XLIV.—*On the Manufacture of Gas from Oil Seeds, in France.* By Daniel Wilson, *Esq.*

[Continued from Vol. I. p. 287.]

We understand that this important and economical method of obtaining gas is making considerable progress, Mr. Wilson being now superintending the construction of

his apparatus, in France; as the importation of such apparatus into France from this country is prohibited.

Mr. Theodore Paul, son of the late scientific Mr. Nicolas Paul of Geneva, (whose improvements in lamps and reflectors we have laid before our readers,) has been many months in this country, qualifying himself to undertake the management of the gas works at Lyons; and is now returned to France.

In this superior mode, the whole of the gas in the seeds may be extracted; whereas, after all the trouble and expense of bruising them and exposing them to pressure, much of the materials capable of affording gas still remains in the oil-cakes; this, Mr. Wilson has satisfactorily proved, by producing gas from the oil-cakes themselves.

We trust, therefore, that this great simplification in the mode of procuring oil-gas, which we consider as a most important discovery, will be adopted in all those countries where the cultivation of the seeds is encouraged:—and we think, that, so far from its being a retrogradation in science, as it has been termed; that it is in reality a very considerable advance in the mode of obtaining light from oil.

The carbon produced in this operation, answers the purpose of the coke or other matters which are now found necessary to be introduced into the retorts, for the purpose of continually affording new surfaces during the process of extracting gas from oil: and, indeed, until this important discovery was made, that process was entirely at a stand; as, instead of affording gas, the oil deposited carbon in the retorts, and very little gas indeed was afforded.

XLV.—*On the Tread-Wheel. By the* Editor.

This excellent application of the human power to the working of machinery, which is now, under the direction of Mr. Cubitt of Ipswich, beginning to be introduced into prison discipline, is highly deserving of being much more extensively employed.

It has long been in use in China; and, as would appear from an Elementary Treatise on Mechanics, published in the year 1800, by the celebrated Swedish engineer, Nordwall, is also in common use in Sweden; he having given no less than three examples of its application in that work. The first of these is given in a comparison with an ordinary walking-wheel of twice and a half its diameter, and in which the labourer is inclosed within the wheel, like a squirrel in its cage, or a turnspit-dog in a wheel; and shewing, that an equal effect is produced, by placing the labourer on the outside of the smaller wheel, his weight being applied to the utmost advantage thereon. The next example shews it applied to a combination of wheel-work, as a first-mover: and the third, as applied to a crane, the weight to be raised being drawn up by a rope winding upon its axis.

In this country, it has been introduced later into use. Mr. David Hardie, several years since, took out a patent for its application as a crane; and several of them were erected in the East India Company's Bengal Warehouses, in New-street, Bishopsgate-street, and are still in use; the work being performed with them by one half the usual number of labourers. A description of this crane, with an engraving, is published in Dr. Gregory's Mechanics.

An earlier and improved application of it was, however, made by Mr. Day, an engineer of Bridgenorth, in Shropshire, and which highly deserves to be made known.

His tread-wheel, instead of being made cylindrical, as usual, was conical, or larger at one end than the other; so that the labourer could accommodate his weight to that of the body to be raised or lowered. For instance, if the weight of the body was small, by treading upon the smaller part of the conical wheel, he was enabled to raise it so much the quicker;—if, on the contrary, it was heavier; by treading upon the larger part of the wheel, he could employ more power, although it necessarily took more time.

Besides this great advantage, it also possessed the property of affording the labourer an opportunity of loading

himself with an additional weight; thus enabling him to employ more power occasionally, and when requisite to raise a heavier body; and the moment the labourer slipped his shoulders from under the beam to which that additional weight was suspended, or whether any such weight was added or not; that moment the crane was prevented from moving, by a brake, which acted on a wheel at the largest end of the cone.

We see, in the instance of a bricklayer's labourer ascending a ladder with a load of bricks, &c. upon his shoulder, and which movement bears a very considerable resemblance to the movement of treading upon the wheel, the possibility of the labourer taking upon himself an additional burden; and therefore how desirable it is, for the crane to be provided with the means of adding to the labourer's weight, when necessary.

There is no doubt that this mode of employing the human power is vastly superior to the ordinary method of doing it by the aid of cranks or winch-handles; and is perhaps only to be equalled by the effect produced in the rowing posture, where the body is supported, and all the muscles are brought into play in the most effectual manner; and both of these methods ought to be employed much more frequently than has hitherto been done.

XLVI.—*Upon the Culture of the* Pine-apple, *without Bark or other Hot-bed. By* THOMAS ANDREW KNIGHT, *Esq.* F.R.S., &c. *President of the London Horticultural Society.**

[Read March 7, 1820.]

IN a communication which I had the honour to send to the Horticultural Society in the last autumn, upon the effects of high temperature, when accompanied by very bright sunshine, upon some species of plants, I mentioned that I had made a few, apparently very successful, expe-

* From Vol. IV. of the London Horticultural Society's Transactions, published in 1822.

riments upon the culture of the pine-apple: but I declined, at that period, to describe the means I had used; because several experienced gardeners in the vicinity were of opinion that my plants could not be made to survive, in health at least, the winter. The same gardeners have since frequently visited my hot-house, and they have unanimously pronounced my plants more healthy and vigorous than any they had previously seen: and they are all, I have good reason to believe, zealous converts to my mode of culture.

I had no intention whatever to attempt to raise pine-apples till the autumn of 1818, when I received from one of my friends in this vicinity, Mr. RICKETTS, of Ashford Hall, some seeds of the mango; and soon afterwards some more seeds of that and other tropical fruit-trees, from one of our members, Mr. PALMER. I then resolved to erect a hot-house, chiefly for the purpose of attempting to cultivate the mango: but I had long been much dissatisfied with the manner in which the pine-apple is usually treated, and very much disposed to believe the bark-bed, as Mr. KENT has stated in our Transactions,* "worse than useless," subsequently to the emission of roots by the crowns or suckers. I therefore resolved to make a few experiments upon the culture of that plant: but as I had not at that period, the beginning of October, any hot-house, I deferred obtaining plants till the following spring. My hot-house was not completed till the second week in June, at which period I began my experiment upon nine plants, which had been but very ill-preserved through the preceding winter by the gardener of one of my friends, with very inadequate means, and in a very inhospitable climate. These, at this period, were not larger plants than some which I have subsequently raised from small crowns (three having been afforded by one fruit) planted in the middle of August, were in the end of December last; but they are now beginning to blossom, and in the opinion of every gardener who has seen them,

* Vol. III. p. 283.

promise fruit of great size and perfection. They are all of the variety known by the name of Ripley's Queen Pine.

Upon the introduction of my plants into the hot-house, the mode of management, which it is the object of the present communication to describe, commenced. They were put into pots of somewhat more than a foot in diameter, in a compost made of thin green turf, recently taken from a river side, chopped very small and pressed closely, whilst wet, into the pots; a circular piece of the same material, of about an inch in thickness, having been inverted, unbroken, to occupy the bottom of each pot. This substance, so applied, I have always found to afford the most efficient means for draining off superfluous water, and subsequently of facilitating the removal of a plant from one pot to another, without loss of roots. The pots were then placed to stand upon brick piers, near the glass; and the piers being formed of loose bricks (without mortar), were capable of being reduced as the height of the plants increased. The temperature of the house was generally raised in hot and bright days, chiefly by confined solar heat, from 95° to 105°, and sometimes to 110°, no air being ever given till the temperature of the house exceeded 95°; and the escape of heated air was then only in a slight degree permitted. In the night the temperature of the house generally sunk to 70°, or somewhat lower. At this period, and through the months of July and August, a sufficient quantity of pigeons' dung was steeped in the water, which was given to the pine plants, to raise its colour nearly to that of porter, and with this they were usually supplied twice a day in very hot weather; the mould in the pots being kept constantly very damp, or what gardeners would generally call wet. In the evenings, after very hot days, the plants were often sprinkled with clear water, of the temperature of the external air; but this was never repeated till all the remains of the last sprinkling had disappeared from the axillæ of the leaves.

It is, I believe, almost a general custom with gardeners, to give their pine-plants larger pots in autumn; and this

mode of practice is approved by Mr. BALDWIN.* I nevertheless cannot avoid thinking it wrong; for the plants, at this period, and subsequently, owing to want of light, can generate a small quantity only of new sap; and consequently, the matter which composes the new roots that the plant will be excited to emit into the fresh mould, must be drawn chiefly from the same reservoir, which is to supply the blossom and fruit; and I have found that transplanting fruit-trees, in autumn, into larger pots, has rendered their next year's produce of fruit smaller in size, and later in maturity. I therefore would not remove my pine-plants into larger pots, although those in which they grow are considerably too small.

As the length of the days diminished, and the plants received less light, their ability to digest food diminished. Less food was in consequence dissolved in the water, which was also given with a more sparing hand; and as winter approached, water only was given, and in small quantities.

During the months of November and December, the temperature of the house was generally little above 50°, and sometimes as low as 48°.† Most gardeners would, I believe, have been alarmed for the safety of their plants at this temperature; but the pine is a much hardier plant than it is usually supposed to be; and I exposed one young plant in December to a temperature of 32°, by which it did not appear to sustain any injury. I have also been subsequently informed by one of my friends, Sir HARFORD JONES, who has had most ample opportunities of observing, that he has frequently seen, in the East, the pine-apple growing in the open-air, where the surface of the ground, early in the mornings, shewed unequivocal marks of a slight degree of frost.

My plants remained nearly torpid, and without growth, during the latter part of November, and in the whole of

* Baldwin's Practical Directions for the Culture of the Ananas, p. 16.

† Subsequently to the time this paper was sent to the Society, I have been informed that the thermometer was once, in the last winter, so low as 40 degrees.

December; but they began to grow early in January, although the temperature of the house rarely reached 60°; and about the 20th of that month, the blossom, or rather the future fruit, of the earliest plant, became visible; and subsequently to that period their growth has appeared very extraordinary to gardeners who had never seen pine-plants growing, except in a bark-bed or other hot-bed. I believe this rapidity of growth, in rather low temperature, may be traced to the more excitable state of their roots, owing to their having passed the winter in a very low temperature comparatively with that of a bark-bed. The plants are now supplied with water in moderate quantities, and holding in solution a less quantity of food than was given them in summer.

In planting suckers, I have, in several instances, left the stems and roots of the old plant remaining attached to them; and these have made a much more rapid progress than others. One strong sucker was thus planted in a large pot upon the 20th of July; and that is beginning to shew fruit. Its stem is thick enough to produce a very large fruit; but its leaves are short, though broad and numerous; and the gardeners who have seen it, all appear wholly at a loss to conjecture what will be the value of its produce. In other cases, in which I retained the old stems and roots, I selected small and late suckers, and these have afforded me the most perfect plants I have ever seen; and they do not exhibit any symptoms of disposition to fruit prematurely. I am, however, still ignorant whether any advantage will be ultimately obtained by this method of treating the Queen-pine: but I believe it will be found applicable with much advantage in the culture of those varieties of the pine, which do not usually bear fruit till the plants are three or four years old.

I shall now offer a few remarks upon the facility of managing pines in the manner recommended, and upon the necessary amount of the expense. My gardener is an extremely simple labourer, he does not know a letter or a

figure; and he never saw a pine-plant growing, till he saw those of which he has the care. If I were absent, he would not know at what period of maturity to cut the fruit; but in every other respect he knows how to manage the plants as well as I do; and I could teach any other moderately intelligent and attentive labourer, in one month, to manage them just as well as he can: in short, I do not think the skill necessary to raise a pine-apple, according to the mode of culture I recommend, is as great as that requisite to raise a forced crop of potatoes. The expense of fuel for my hot-house, which is forty feet long, by twelve wide, is rather less than seven-pence a day here, where I am twelve miles distant from coal-pits; and if I possessed the advantages of a curved iron roof, such as those erected by Mr. LOUDON, at Bayswater*, which would prevent the too rapid

* These are formed of Messrs. W. & D. Bailey's, of Holborn, Patent wrought iron sash-bars. A much more extensive erection has, however, been recently completed by them, at Messrs. Loddiges' Nursery, at Hackney, consisting of a conservatory 120 feet long, 23 feet wide, and 18 feet high; it is erected against a range of green-houses, and has its front to the north. The bars are inserted and securely fixed into a cast-iron curb or coping-plate on the front wall, and into a cast-iron rail at the back, supported by standards, between which sashes are hung. The curved roof bars are continued from one end of the conservatory to the other; and being of themselves sufficiently strong, they supersede the necessity of the ordinary wide rafters, sash-frames, and supports, which occasion so much shade in houses constructed of wood: and the trifling obstruction which the iron bars present to the rays of the sun, (they being very much narrower than wooden bars,) gives to the roof the appearance and effect of one immense sheet of glass.

The conservatory being six feet higher than the wall of the green-houses, the row of opening sashes at the back ventilates it most effectually above, and the door, and three arches through the wall of the green-houses, admit air below.—Other similar erections have been made by Messrs. Bailey's in the neighbourhood of the metropolis; and curvilinear roofs have been supplied by them to T. A. Knight, Esq. the Author of this paper, of Downton Castle, and to Sir W. R. Boughton, Bart. Downton-Hall, Salop; who, finding every theoretical objection removed on trial, have expressed the highest approbation of the principle, and their conviction of the economy and success attending the use of these roofs in glazed houses; and we have been highly gratified, on a recent visit to Messrs. Loddiges, at the light and elegant appearance of the conservatory, and the healthy appearance of the valuable collection of camelias with which it is filled, and which promise an abundance of flowers next spring. The form of the bars is admirably adapted to this purpose, their section being similar to across, which affords great strength and lightness to the buildings formed

escape of heated air in cold weather, I entertain no doubt that the expense of heating a house forty-five feet long and ten wide, and capable of holding eighty fruiting pine-plants, exclusive of grapes and other fruits upon the back wall, would not exceed four-pence a day. A roof of properly curved iron bars appears to me also to present many other advantages: it may be erected at much less cost—it is much more durable—it requires much less expense to paint it, and it admits much more light.

I have not yet been troubled with insects upon my pine-plants, and have not, of course, tried any of the published receipts for destroying them. Mr. BALDWIN recommends the steam of hot fermenting horse-dung*: I conclude the destructive agent, in this case, is ammoniacal gas; which Sir HUMPHRY DAVY informed me he had found to be instantly fatal to every species of insect†; and if so, this might be obtained at a small expense, by pouring a solution of muriate of ammonia upon quick-lime; the stable or cow-house would afford an equally efficient, though less delicate fluid. The ammoniacal gas might, I conceive, be impelled, by means of a pair of bellows, amongst the leaves of the infected plants, in sufficient quantity to destroy animal, without injuring vegetable life: and it is a very interesting question to the gardener, whether his hardy enemy, the red spider, will bear it with impunity.

The following Paper, in continuation of this Subject, was read November 6, 1821.

Writers, who have recommended new modes of practice upon the authority of their own observation and experience, have generally been accused, and often with sufficient rea-

formed of them: and we understand that the cost of such erections does not exceed that of wooden ones of the best construction.—EDITOR.

* Baldwin's Practical Directions, &c. p. 30.

† The tobacco worm, however, appears to form an exception; as that is found in great numbers, upon the walls of the close chambers where the tobacco is fermented, and ammonia is extricated most abundantly.—Remark by the Editor of the Technical Repository.

son, of condemning every thing which had previously been done, as wrong, and absurd; and of asserting their own practice alone, to be reasonable and right. I fear that in the opinions, which I have given, and which I proceed to give, relative to the *culture of the pine-apple*, I shall incur the risk of subjecting myself to similar charges. But I beg it to be understood, that I condemn the machinery only, which our gardeners employ; and that I admit most fully their skill in the application of that machinery to be very superior to that which I myself possess. Nor do I mean, in the slightest degree, to censure them for not having invented better machinery; for it is their duty to put in practice that which they have learned; and, having to expend the capital of others, they ought to be very cautious in trying expensive experiments, of which the result must necessarily be uncertain; and I believe a very able and experienced gardener, after having been the inventor of the most perfect machinery, might, in very many instances, have lost both his character and his place, before he had made himself sufficiently acquainted with it, and consequently become able to regulate its powers. I still feel that I have much to learn in the management of my machinery, though I possess more than sufficient evidence to enable me to assert with confidence, that, in the culture of the pine-apple, the bark-bed, or other hot-bed, is worse than useless, after the scions, or crowns, have emitted roots; and that the pine-apple, when treated in the manner I have recommended, is a fruit of most extremely easy culture.

It is contended in favour of the bark-bed, that the soil in inter-tropical climates is warm, and that the bark-bed does no more than nature does in the native climate of the pine-apple. And if the bark-bed could be made to give a steady temperature of about ten degrees below that of the day-temperature of the air in the stove, I readily admit that pine-plants would thrive better in a compost of that temperature, than in a colder. But the temperature of the bark-bed is constantly subject to excess, and defect; and I con-

tend, and can prove, that the above-mentioned temperature is very nearly given in my stove. For the temperature of the day being about 90° or 95°, and that of the night 70°, the mould in the pots will necessarily acquire nearly the intermediate temperature of 80°. It is true, that two disturbing causes are in action; the evaporation from the mould and porous surface of the pots, and the radiant heat of the sun. But these causes operate in opposition to each other, and probably nearly negative the operation of each, as far as respects the temperature of the mould in the pots.

A very great number of gardeners have within the last twelve months visited my garden. Some of these were at once convinced of the advantages of the mode of culture which they saw; others have paid a second, or third visit; but every one has ultimately declared himself a zealous convert. I have never yet seen plants of the same age equally strong, nor any producing fruit better, nor indeed so well swelled; nor any equal in richness and flavour. But I have never taken off, nor shortened a root, nor taken any other measures to retard the period of fructification, with the prospect of obtaining larger fruit; and my plants have almost always shewn fruit when fourteen or fifteen months old, though propagated from small and young suckers or crowns. A great part of my Queen-pines (I have hitherto scarcely ever cultivated any other varieties) have, however, at that age, shewn fruit with eight, and some with nine rows of pips; and I often see fruit of less weight growing upon plants of nearly double that age. Whether I shall be able to retard the period of fructification, or not, I have yet to learn; but I believe I shall succeed by crowding my plants close together, so that each may receive less light.

I have tried a variety of composts, and of these I have found that which I described in a communication relative to the culture of the cocks-comb,* to be the most stimula-

* This compost was the most nutritive and stimulating that I could apply, consisting of one part of unfermented horse-dung fresh from the stable, and without litter, one part of burnt turf, one part of decayed leaves,

tive of growth. Pine-plants will, however, grow perfectly well in composts of different kinds; but I have found that they have succeeded best, when the materials have been fresh, and retaining their organic form, particularly if the pots be large, relatively to the size of the plants, which, I think, they ought always to be, for the mode of culture recommended. I have used with advantage, the haulm of beans, cut into lengths of about an inch.

Very contrary to the conclusions which I should have been led to draw from writings upon the culture of the pine-apple, I have constantly found that my plants succeed best in that part of my house where the flue first enters, and where the temperature is very high, varying from about 85° to 105°, and the air excessively dry. I have pointed out this circumstance to every gardener whom I have seen in my house, and all have expressed their astonishment at the result. I expected that this excess of heat would have occasioned the plants to shew fruit prematurely, but this has not occurred in a single instance. What would be the quality of the fruit, if it were to be ripened in so high a temperature, I have not yet had an opportunity of knowing.

In raising young plants, I have deviated from the ordinary mode of practice, by breaking off the suckers when very young; that is, when they are not more than four or five inches long. The fruit is much benefited by their absence; and the cuttings, if placed very close together in a hot-bed, are made to emit roots with little trouble, and afford better plants than they do when they are suffered to remain long upon the parent-stem. When the whole are removed at an early period, one or more very strong suckers usually spring out below the level of the soil; and from these, suffering only one to remain attached to the

leaves, and two parts of green turf, the latter being in lumps of about one inch in diameter, to keep the mass so hollow that the water might have free liberty to escape, and the air to enter. Manure was also given in a liquid state by steeping pigeons'-dung in the water, which was given very freely.

parent-stem, and preserving the roots as entire as possible, I have propagated with much advantage, and have obtained plants which shewed fruit strongly at seven months, dating from the period at which the sucker appeared, like a strong head of asparagus, at the surface of the soil.

The success of my experiments, in the first house which I erected, (and to which the foregoing account exclusively refers,) led me to erect another house in the summer of 1820. In this I attempted to obtain the greatest possible influence of light, and command of solar heat; inferring, from having observed pine-apples to ripen tolerably well with very little light, that I should be able to ripen them in perfection late in the autumn, and early in the spring, particularly at the latter period, in which alone, I set a very high value upon this species of fruit. The height of the back wall of this house is eight feet six inches, and that of the front wall is one foot six inches, and its breadth ten feet, inside measure, with an iron curvilinear roof, of the kind of bar invented by Mr. LOUDON, of Bayswater*. This house is fifty feet long, and capable of containing two hundred fruiting pine-plants. The curvature of the roof rises just one foot in twelve. The glass is laid in a composition of two parts white lead, with oil, and three of flint-sand, and the overlaps of the glass are closely filled with the same material†. It is, consequently, very nearly air-tight; and no means are given for the air to enter, or escape, except by apertures immediately under the copings of the front and back wall, which can be efficiently closed at any time. It is, consequently, an instrument of very great power, and requiring, of course, much attention to ventilation: of which I had rather a lamentable proof in the last spring, when my plants were all burned, and spoiled in a few hours; the person who had the care of them, having left them in

* Or rather by Messrs. Baileys, of Holborn.—EDITOR.

† This material appears admirably calculated to fill the overlaps in all cases; but its excessive hardness, and firm adhesion, must preclude the use of it, except to fill the overlaps, when the bars are made of wood.

a bright day closely shut up. The fault was not, however, in any degree in the house, for the plants were previously much the strongest and the best I ever saw; and I believe, they would have afforded the most beautiful fruit. I furnished the house again with plants as expeditiously as I could, chiefly in July; and I have since kept the temperature of it nearly between 70° and 95°, with a wish to make the plants shew fruit and blossom in the present month (October). In this I have in part succeeded, though many of my plants have flowered a fortnight or three weeks sooner than I wished. The fruit is swelling well, and, I believe, will receive sufficient light through the winter to enable it to ripen in much perfection. The excellence of a few pine-apples, which ripened in this house last winter, leads me almost to doubt whether the fruit in it will not ripen better early in the spring than in the middle of the summer; for I have observed that this species of plant, though extremely patient of high temperature, is not, by any means, so patient of the action of very continued bright light, as many other plants; and much less so than the fig and orange-tree: possibly, having been formed by nature for inter-tropical climates, its powers of life may become fatigued, and exhausted by the length of a bright English summer's day, in high temperature. Being a plant of low stature, nature has also probably given it a power to ripen its fruit, and seed, in the shade of other plants, in its native climate; and I discovered in the last summer, that it possesses the power to ripen its fruit perfectly in a lower temperature than I previously thought it capable of growing in.

In the month of June, I gave a couple of pine-plants, which had shewn fruit at six months old, and were of small size and no value, to a child of one of my friends, to be placed in a conservatory, in which no fires were kept during the summer. In July, a storm of hail destroyed nearly, or fully, half the glass of the conservatory; and its temperature, through the summer and autumn, had been so low

that the Chasselas grapes in it were not ripe in the second week in September. In the second week of the present month (October) one of the pine-apples became ripe, having previously swollen to a most extraordinary size, comparatively with the size of the plant; and upon measuring accurately the comparative width of the fruit, and of the stem, I found the width of the fruit to exceed that of the stem in the proportion of seven and three-quarters to one. The fruit had, of course, been propped during all the latter part of the summer, the stem being wholly incapable of supporting it. The taste and flavour of this fruit were excellent, and the appearance of the other, which is not yet ripe, and of a larger size, is still more promising. I purpose to profit by this result in the next summer; and I hope to be able to communicate some further information to the Society in the autumn. I feel perfectly confident, that if the roots of these plants had grown in a hot-bed of any kind, their sap would have been impelled into other channels; and their fruit would not have attained, in any degree, the state of perfection which I have described.

XLVII.—*Upon the Management of* Fruit Trees *in* Pots. *By* Thomas Andrew Knight, *Esq.* F.R.S., *&c. President of the London Horticultural Society.**

I. have more than once mentioned, in the Transactions of this Society, the importance of giving to fruit-trees, from which a crop of fruit is required very early in the season, a high degree of excitability, or the power to vegetate very strongly in moderately low temperature, at the period when they are first subjected to artificial heat: and I have pointed out the advantages of retaining all trees which are intended to afford such very early crops, in pots. In the present season, I have endeavoured to ascertain within how short a period, in the ordinary temperature of my pine-

* From Vol. IV. of the Transactions of the Horticultural Society of London.

stove, plants of the Chasselas and Verdhelho vine could be made to yield mature fruit.

The subjects of this experiment had produced a crop of fruit previously to midsummer, 1820; and in the following month of July, they had been taken from the stove, after having been for some time sparingly supplied with water, and placed under a north wall; in which situation they remained nearly torpid till autumn, when they were pruned. Early in the winter I observed in them strong symptoms of a disposition to vegetate, though they remained in the cold and shaded situation in which they were first placed, when removed from the stove: and on the 12th of January I found the buds so much swollen, that I feared the exposure to frost would prove fatal to them; and the pots were consequently removed to the stove. In this, the sudden increase of temperature occasioned every visible bud to unfold itself within a very few days; and on the 17th of the following month, being thirty-six days after the pots were brought into the stove, the berries of some bunches of the Verdhelho grape were so far grown, that I could have thinned them with advantage. In the end of March the Chasselas grapes became soft and transparent; and in the middle of April some bunches were as mature, and much more yellow, than those of the same kind usually are when first brought to the London market in the spring; though the weather had been, during the earlier part of the spring, dark and cloudy, and consequently unfavourable. The wood of these vines appeared nearly mature in the end of the last month (April); and by removing them from the stove for a short time, to a cold and shaded situation, and subsequently replacing them in the stove, I do not doubt the practicability of obtaining another crop from them within the present year.

A pot which contains a quantity of mould equal to a cube of fourteen inches, has been found large enough for a vine whose foliage occupied a space of twenty square feet; water holding manure in solution being abundantly given: and I have seen grapes acquire a larger size, and

other fruits a higher flavour, under such management, than under any other.

The supposed necessity of frequently removing fruit-trees, which grow in pots, to other pots of larger dimensions, appears to present a good deal of inconvenience: but I have readily obviated this necessity, by means which I can confidently recommend to the attention of gardeners. When the plant, or fruit-tree, is first placed in the pot in which it is to remain, I mix with the compost some material, in greater or lesser quantity, which is capable of ultimately affording nutriment, but which will decompose slowly. In some cases I have used with success, slender half-decayed branches from my wood-pile; and in others I have employed sound chips, chiefly of apple-tree, mixed with mould, and in sufficient quantity to occupy at least one-fourth of the space afforded by the pot. As the roots of the plant increase, the lifeless wood gradually decomposes, at the same time giving food and space to the roots; which, consequently, do not become injuriously compressed in the pot. I possess a nectarine-tree which has grown nine years in the same pot, and which vegetated more strongly in the present spring than I can recollect it previously to have done. Several successive crops of fungi usually appear upon the surface of the pots under the preceding circumstances; but I have had no reason to think these injurious.

The trouble of conveying water to numerous pots, in hot weather, would be very considerable; but a simple mode of applying the very ingenious contrivance of Mr. LODDIGES, by which water is dispersed, as in showers, upon the foliage of his plants, and which has been described in the Society's Transactions*, would reduce this labour to the act of turning a cock: and if it were desirable to diminish, or wholly take away, the supply from any particular pot, this might easily be effected by partially or wholly closing the apertures through which the water is made to escape from the pipe.

* See Vol. III. p. 14.

XLVIII.—*On the Manufacture of Nitric Acid, in France.*

Nitric acid, aqua-fortis, spirits of nitre, was discovered by Raymond Lully, on distilling a mixture of nitre and argillaceous earth. Cavendish first pointed out its elements; Gay-Lussac, Davy, and Dalton, studied its properties, which were generally known by their numerous applications in the arts, and their frequent employment in chemical essays. As this is by far the most important combination of azote with oxygen, we shall begin by making some observations on the three principal combinations, the knowledge of which will be useful in the explanation of some phenomena which their facile changes present. These, however, have no direct application to the arts.

Protoxide of azote, the discovery of which is due to Priestley, is white and colourless; neither oxygen nor atmospheric air have any action upon it: by the aid of heat, it readily yields its oxygen to combustible bodies, and the azote is set at liberty: it supports combustion better than common air, and will re-illumine a taper plunged into it at the moment of its extinction, while the least particle of incandescence remains. Water at 10° of temperature dissolves one-half of its volume: a boiling heat disengages it entirely. One volume of azote and rather more than half a volume of oxygen condensed together, form one volume of this gas; or, in weight, 100 of azote and 56 of oxygen. This gas has also been called the *exhilarating gas*, on account of the agreeable sensations which the English chemists first discovered to have been felt on inhaling it. A contrary effect has, however, been experienced by some other chemists, who nearly fell into asphyxia from its effects; but it appeared that this was occasioned by the presence of a small portion of nitrous acid; and it has been recommended to cause it to pass through a solution of pot-ash, that its purity may be ascertained, before making use of it for the purpose of respiration. Deutoxide of azote was

* From the *Dictionnaire Technologique.*

also discovered by Priestley, who pointed out the greater part of its properties, which were afterwards studied by Davy, Gay-Lussac, &c. It is a permanent gas in all temperatures, colourless, and has no action on blue vegetable colours; it extinguishes flame, and produces asphyxia in animals; it absorbs the oxygen of the air (one volume): it is composed of two volumes of oxygen and one of azote; becomes red and opaque, and easily passes to the state of nitrous acid. This property is its distinctive character; and it is on this account that it acts so important a part in the manufacture of sulphuric acid*. It is also on account of this transformation to nitrous acid, that the deutoxide of azote acts so strongly on the animal economy. This gas is obtained by dissolving copper or mercury in nitric acid, with which it forms the deutonitrates of these metals; the oxygen, freed from one part of the nitric acid, leaves a corresponding quantity of deutoxide of azote. It is likewise obtained by the reaction of nitric acid on molasses, sugar, starch, gum, and other combustible bodies,† to which it readily yields one part of its oxygen. That which is the most pure, is obtained by a solution of mercury in diluted nitric acid:—it is composed of one volume of oxygen and one of azote.

The nitrous acid, composed of two volumes of oxygen and one of azote, not being yet saturated with this last gas, —in effect it discolours the sulphate of manganese, by deoxidating it,—it is anhydrous and liquid at the ordinary temperature; colourless at 20° below zero, of a yellow amber colour at zero, and of a yellowish orange at from 15 to 28°; it boils at this temperature, and is reduced into red vapours; it combines with the nitric acid, and tinges it of a greenish yellow orange, or reddish brown colour, according to the degree of concentration. The nitrous acid is not directly employed in the arts.

* Its combination with this concentrated acid is effected instantaneously, and crystallizes: it is decomposed by water.

† See our articles on the *Manufacture of the Oxalic and Sulphuric Acids, in France.*

Lastly, the combination of azote with oxygen in the proportion of one volume of the first, to two and a half of the second; or, in weight, azote 35,12, oxygen 100.—This combination, to which, (according to the system of the new nomenclature) we ought to give the name of *azotic acid*, still preserves the denomination of *nitric acid*.

Manufacture.—This acid may also be obtained by decomposing the nitre by means of argillaceous earth in earthen retorts called *cuines:* the residuums of this operation were used in the manufacture of alum, because they contained two of the constituent principles of this triple salt, potash and alumine. This decomposition was afterwards effected in the same retorts, by sulphuric acid; but latterly cast-iron has been substituted instead of earthen vessels, and the boilers have been made in the form of retorts.

We shall say but little concerning this apparatus, as it is now generally exploded. It is composed of six boilers, placed in the same furnace, in a double row, over six fire-places: they are covered, luted, and communicate by earthen tubes with a series of seven or eight earthen vessels or receivers, the two first of which are plunged to half their height in troughs of water*.

As this process, however, is still employed in some laboratories, we shall here point out its chief inconveniences. Cast-iron is less acted upon by sulphuric, nitric, or hydrochloric acids, when it is most strongly heated; the covers and the upper edges of the boilers being beyond the action of the fire, are more easily attacked; and this difference produces in the manufacture a two-fold disadvantage. The wear of the vessels is more considerable, and the nitric acid, by attacking the iron, becoming decomposed, is changed into nitrous acid; and this decomposition not only causes the loss of the nitric acid, but it costs more in the rectification, to drive off the condensed nitrous acid, which leaves the nitric acid of a yellow or red colour. The temperature not being suffi-

* See a description of a similar apparatus, in our article on the *Manufacture of the Hydrochloric Acid, in France.*

ciently raised, or rather not being sufficiently equal, the nitrate of potash is not so well decomposed, as in the process which we are now about to describe; the residuums also contain nitric acid; and, finally, their adhesion to the bottoms of the boilers is so strong, that the workmen cannot raise them without great difficulty, and running the risk of breaking the cast-iron by the repeated blows of the chisel which they are obliged to give: this work is rendered still more painful by the heat which the men endure, when the operations succeed each other rapidly, as is usually the case;—the heated surface (that is to say, the heat through which they pass, to arrive at the mixture contained in the boilers) being more considerable than that which is presented by the cylinders; the operation, in the first case, is of longer duration, the action less general, and more combustibles are employed, &c.

The apparatus to which we give the preference is usually composed of four cylinders in the same furnace; they communicate by tubes with three or four rows, or ranges, of earthen vessels, the two first of which are plunged in water*. The tubes which are immediately adapted to the cylinders are of glass†, in order that the colour of the gas which passes may be seen, as it shews the progress of the operation: the other tubes may be of earthen-ware. In short, the same means are employed as in the manufacture of hydrochloric acid:—turf, wood, or pit-coal is used, according as the situation may afford either of these combustibles most conveniently; and we shall give an account of their effects respectively. Turf, yielding less heat in an equal volume, requires, to produce the same effect, a space more considerable than pit-coal; and also, volatilizing less carbon than pit-coal, consumes in combustion a less volume of air; and a less draft is generally required for wood.

* See a similar apparatus described, in our article on the *Manufacture of the Hydrochloric Acid, in France.*

† It is necessary to place between the joinings of the cast-iron and the glass tubes, a small piece of tube of earthen-ware, usually 12 or 15 centimetres long, to defend the glass tubes from the too great heat.

Proportions:—Nitrate of pot-ash 100—sulphuric acid at 66° or 1845, specific gravity 60; if (as is the case in those laboratories where nitric acid is produced less pure), we employ sulphuric acid not concentrated at 55°, we must use 80 per cent instead of 60. Sulphuric acid, at this degree, costs less, it is true; but this proposed economy is illusive: in effect, the nitric acid thus obtained is less pure, and contains less real acid; and the wear of the cylinders is very considerably greater;—lastly, it requires more combustible matter to volatilize the additional quantity of water; and these inconveniences counterbalance, and more than counterbalance the saving which was aimed at.

Before we employ the nitrate of potash, it is necessary to be assured of its purity; this knowledge will determine the choice and price of the saltpetre which we meet with in commerce. In all its states, it always contains foreign salts, and particularly the hydrochlorates of potash, lime, and magnesia, which are decomposed by the sulphuric acid, and afford chlorine and nitrous acid; it is necessary, in order to free the saltpetre as much as possible from these salts, to treat it by three successive washings with a *courte eau* (the water employed forming, in the whole, about four centiemes of its weight); it is poured in drops upon the salt placed in hoppers; * when it has been well treated in this way, they take two-thirds in height of the contained nitre, the lower part being reserved to be treated anew. They put into each cylinder 85 kilogrammes of nitrate of potash, and 50 kilogrammes of sulphuric acid at 66°. They lute all the joints of the apparatus with potter's earth (alumine), which they cover with loam mixed with horse-dung; the first, or aluminous earth, is not attacked by the acid; and the second envelopes the argillaceous

* The form of these hoppers is that of a quadrangular truncated pyramid. We must use three, in order that the solutions, in drops, may pass from the one into the other, and be completely saturared with the foreign salts: pure water is used at last. We propose, in this operation, to purify the nitrate of potash, and to dissolve the least possible quantity of it; the mother waters, which, as we have said, have passed thrice through the saltpetre, are treated apart.

earth, and supporting it by its humidity, and the mixture of horse-dung in it, prevents it from cracking. The heat, as we have before observed, must be applied equally, and the fire conducted slowly. It is known that the operation is advancing when the vapours become red, and that it is finished when these vapours are no longer visible; a brisk fire is made at last, to disengage all the gas; they dilute, and easily remove the sulphate of potash, by means of iron tongs. The acid condensed in the first row of vessels is the least pure; it may be employed without rectification in the manufacture of sulphuric acid: that contained in the second range, and part of the third, contains only nitrous acid; this is disengaged by carrying it to the boiling point in glass retorts; the ebullition is gradually stopped, when it becomes white; it is sold in commerce in this state, and should mark 36° of Beaumé's areometer. All the weak acid condensed in the last vessels, is again put into the first or second range, for a succeeding operation, instead of pure water. Water is always put into the last row of bottles, in order that the condensation may be complete.

The acid thus obtained, and sold in commerce, is not sufficiently pure for all the purposes for which it is designed; it always contains a little nitrous acid and chlorine, proving that the decomposition of the muriatic salt, &c. was not complete in the saltpetre; it also sometimes contains sulphuric acid. To purify it, it must be distilled in glass retorts, taking care to separate the products. The first portions volatilized are chlorine and nitrous acid: these are separated when the liquid contained in the retorts is become white, or of a light amber colour; or, without waiting for it to become white, after it has sustained a slight ebullition, they then collect the pure nitric acid: the distillation should be carefully conducted until nine-tenths of the acid put into the retort be volatilized; but we must stop here; for, beyond this period, we shall only obtain sulphuric acid. The nitric acid, thus rectified,

is not even yet sufficiently pure for assaying the precious metals.

Its uses.—Nitric acid is employed in the manufacture of sulphuric, oxalic, and other acids; it serves to dissolve the mercury employed in the *secretage*, or working the hair, in hat-making; to dissolve metals, for etching copper, and to form *hydrochloronitric* acid, or *aqua regia*: it is employed in the manufacture of the red precipitate, or the deutoxide of mercury; in dyeing, gilding, assaying money, and in the parting of gold: 38 parts of acid, at 36 degrees, or 1335 specific gravity, 2 of hydrochloric (muriatic) acid, at 24 degrees, or 1200 specific gravity, and 25 parts of water, form the liquor employed by jewellers in their trials with the touchstone.

Properties. Theory.—The nitric acid is not known to us in a state of purity; it does not exist anhydrous; condensed, by the help of water, it is white, very acid, of a strong smell, and acts violently upon the animal economy. One drop, let fall upon the skin, disorganizes it, and produces a yellow spot; it is in this way that it destroys warts. It is a very violent poison: concentrated, its boiling point is at 86°; it is decomposed by light, and gives birth to nitrous acid, which colours it red, or brownish red, and to oxygen. It yields white vapours in a moist atmosphere, which attack almost all the metals; we must, however, except gold, platina, irridium, tungsten, columbium, cerium, titanium, rhodium, and osmium—(it however dissolves an alloy of twelve parts of silver, and one of platina): very concentrated, heat weakens it; and when it is weak, it is concentrated by heat; very weak, or highly concentrated, its boiling temperature is at 86 degrees; it increases by degrees during the early period of its concentration, and it weakens towards the latter part, until it arrives at its culminating point, which is at 122 degrees.

The theory of the process by which the nitric acid is extracted from the nitrate of potash, is very simple: the sulphuric acid combining with the potash, yields the nitric

acid, become free to the twenty centiemes of water which it contained; the heat which is disengaged, unites it to this water, without which it would be decomposed; but it is sufficient to cause it to exist in a liquid state; it contains also the water of crystallization. Its heat of volatilization is afterwards raised in the vessels of the refrigerating apparatus, and the water which it there meets with attracts it, and finishes its condensation. The red vapours, more conspicuous at the commencement and towards the end, but which disappear in the course of the operation, are owing to the decomposition of the nitric acid, caused principally by the absence of water. 1st. So long as the mixture contained in the cylinders is not completely liquified, and while some portions of nitric acid are disengaged without meeting with water, they are instantaneously decomposed into nitrous acid and oxygen. 2d. The same decomposition is effected by those portions of the mixture which are in contact with an excess of sulphuric acid, which dissipates the water of the nitric acid formed, and causes the red vapours which are remarked in the commencement of the process; and, when the operation is nearly terminated, the nitric acid, which is disengaged at this period, is again decomposed into nitrous acid gas and oxygen, by the high temperature to which it is exposed, and from which the second appearance of the red vapours is derived.

P.

XLIX.—*On the Preparation of Hair Pencils and Drawing-Pens, for producing Fine Strokes. By Mr.* EDMUND TURRELL, *Engraver. In a Letter to the* EDITOR.

WITH A PLATE.

No. 46, Clarendon Street, Somers Town, August 19, 1822.

DEAR SIR,

THE very beautiful specimens which some of our most celebrated draughtsmen produce in the architectural and mechanical departments of drawing, and more particularly in their outlines, has induced me to observe, with parti-

cular attention, the means employed by them; and having found that much depends upon the preparation of the hair pencils and the drawing-pens, I shall endeavour, in what follows, to explain the nature of each, and the best methods I am acquainted with of preparing them for their intended purposes.

The use of the common quill is so well known, that I find I cannot make myself better understood than by describing the nature and manner of its action; by which means I shall lead the mind of the young artist to understand the theory upon which all drawing-pens are constructed.

When a common quill is cut to a point without any slit, letters or characters may be formed with it when charged with ink; but the supply of ink is very uncertain, on account of the liability of the ink to draw up and collect above the point. To remedy this inconvenience, a slit is formed by splitting the quill, which naturally closes, so as to leave only a very slender division, which acts as a capillary tube to convey and keep a supply of ink down to the extreme point, or what is commonly called the nib; the point being formed of a portion of the quill, and the slit before named being exactly in the centre. It will, if examined, appear, therefore, that the slit forms a kind of capillary tube for the supply of ink to the point, and that the point formed on each side thereof serves to spread the fluid; and as the slit permits the two sides forming the point to separate to a certain distance, when pressed upon, a broader or narrower line is formed at the discretion of the writer.

It is frequently found, when pens have been used in ink, and afterwards suffered to dry, that the two sides forming the nib or point separate so wide, that the capillary attraction of the slit is destroyed by its openness, and the pen, in this state, will not produce a mark at all, until it is mended, by forming a new slit. The same inconvenience occurs if ever the two sides of the nib are sepa-

rated, however short the distance; which circumstance proves, beyond a doubt, that a pen cannot be fit for use without the capillary attraction of the slit is perfect to the extreme point or nib. The observations here made will, of course, be generally known: it is on this account I have called the attention of the reader to them, that I may be the more easily understood in my description of the properties of the drawing-pen.

Fig. 1. Plate VIII. represents the lower part of a common quill pen (upon a magnified scale) in a perfect state, fit for writing.

Fig. 2. represents the same when dried, and having the slit opened, so as to prevent the capillary attraction being perfect down to the nib.

Fig. 3. shews a similar figure, with the slit imperfect near the bottom only, but sufficiently so, to prevent the pen from writing properly.

Fig. 4. represents a pen with one side of the nib longer than the other. Such a pen would not write, because the longest point would touch the paper first, and, as the capillary tube is above it, there would be a want of supply; and, consequently, no mark could be well made with it.

Fig. 5. shews the two parts or sides of a steel drawing-pen, on an enlarged scale, as they appear when properly prepared and fit for use; the two ends are exactly of the same length, and the inner sides, near the point or end, are each reduced to a flat surface, so that they may be brought in close contact by means of the screw (*a*): by this arrangement and construction of the parts, when carefully prepared, a very perfect species of slit is formed; and with this peculiar advantage—that it may be adjusted within certain limits, and thereby a fine or dark line produced at pleasure. The drawing-pen, constructed and prepared in this way, differs from the quill-pen in one particular, namely, in being only capable of drawing lines equally thick; additional pressure producing no increase in the breadth of the line.

In using the drawing-pen, it frequently happens that a portion of the pile of the paper gets into the slit or division between the sides, and prevents the pen from making a mark:—to remedy this, most persons force in between the slit either the point of a pen-knife or a thin piece of metal, which almost invariably produces the effect shewn at Fig. 6. where it will be seen that the extreme points are curved: and consequently, the capillary attraction not continuing down to the point, the instrument refuses to make a mark; and as the two points are separated, each will tend to cut up or raise the pile of the paper much more than when the pen is in proper order; because, in that case, the two sides are so connected, as in a great measure to prevent that evil. All the figures are drawn upon a magnified scale, that the minute parts may be the better understood, which I have considered of the first importance in a work whose principal object is practical information.

Should these observations be deemed worthy a place in your useful Repository, I will, at a future opportunity, give some hints on the preparation of hair pencils.

I am, Dear Sir, your's respectfully,

T. Gill, *Esq.* E. Turrell.

[*To be continued.*]

L.—*On the Affinage (or Refining) of Gold and Silver, in France.**

In the Arts, the name of *affinage* (or refining) is given to the purifying of different substances; but this expression is more especially employed to designate the purification of gold and silver.

In many of the employments of gold and silver, it is necessary that these two metals should be in a state of absolute purity, because it is only then that they possess the

* From the *Dictionnaire Technologique.*

malleability requisite for the purposes they are designed for. The leaves, so light and thin, which the gold-beater obtains by hammering, are the product of a metal entirely free from copper; the smallest portions of alloy communicates such a hardness to these two metals, that it becomes impossible to give them that extreme degree of tenuity which is necessary in many of the arts. Gold and silver do not waste in this process, because they possess nearly the same degree of malleability; but the great difference which exists in their respective values, renders them not capable of being sold in commerce, until after they are completely separated the one from the other, and which is the principal aim of the refiner.

If the alloy which is proposed to be refined contains only gold, silver, or copper, it becomes useless to submit it to a preliminary purification; but as it almost constantly happens that the fused masses contain tin, and often even lead, acquired in the operation of refining, we are obliged previously to free these matters from the least remains of all the foreign metals, leaving the two only to which we give the title of fine, so that we have only to perform the subsequent operation of separating the gold from the silver. This first purification is termed *la poussée*, because its effect is to *push* the refining as far as possible. I will now describe in what manner it is performed. We commence by ascertaining, by means of the process known by the name of *assaying*, the real title under which the matters submitted to the operation have to be considered: if the gold predominates sufficiently to form more than a fourth part of the alloy, they determine the proportion of silver necessary to be added to perform the process of *quartation*. It is indispensably necessary thus to increase the quantity of silver; as we have always observed, that when the alloy contains a less portion, it is in some way defended from the action of the acids by the gold; whereas when the alloy is formed of at least three parts of silver to one of gold, the acid easily penetrates the whole substance of the mass, and extracts even

the smallest portions of silver. These proportions being well determined, we place a good earthen crucible in the midst of charcoal in a wind-furnace, and give it a good red heat; we then put into the crucible as much of the mass as, on being fused, will nearly half fill it;—we generally fuse from 15 to 20 marcs at once. As the metal is ready to fuse, we add half a pound of nitrate of pot-ash; we then close the crucible, and cover it with charcoal. At this time the heat must not only be sufficiently intense to fuse the alloy, but also to effect the decomposition of the salt-petre, and the oxidation of the baser metals; it produces a considerable ebullition, sufficient to effect the disengagement of the gas which is then formed; and it is on that account that the crucible should only be half filled. When the matter is perfectly fused, which is known by stirring it with an iron rod, we augment the fire; and the fusion having become tranquil, and the scoriæ entirely separated, the crucible is withdrawn from the furnace, and left to cool: it is afterwards broken, and we find an homogeneous button, which we detach from the scoriæ with which it is covered. These scoriæ contain much caustic potash, and are powerfully affected by the humidity of the atmosphere. They contain also the oxides of copper and tin, and sometimes of lead and iron; we also find in them a small quantity of an alloy of gold mixed with silver: all these scoriæ are put aside; and when a large quantity is collected, they are fused with charcoal powder, and the alloy obtained is submitted to *cupellation.*

The mass of gold and silver which is produced by the *poussée* is fused anew, and reduced into grains by being poured into a vessel of water, at the bottom of which a copper vessel is placed. We thus divide the metal to cause it to present a greater surface, and to facilitate its solution; and we therefore endeavour to obtain it in the smallest grains and thinnest leaves possible, which is readily done by pouring the metal into the water, from a certain height above it, taking care that the thread of fused metal should

be as small and as much continued as possible. We raise the basin which contains the grains, decant the water from them, and dry them over the fire. We finally distribute these grains into glass matrasses with broad bottoms, earthen bottles, or vessels of platina, which we place in a gallery furnace, and pour into each vessel two or three parts of nitric acid, at 30° or 35°; we slightly heat them, to facilitate the action of the acid; the acid is soon decomposed, nitrous gas is disengaged, and the solution is effected. When the effervescence has ceased, we decant the fluid, and pour on a small quantity of fresh acid: it is again heated almost to ebullition; we decant afresh, and then add a third and last portion of acid, but more concentrated, and which is also made to boil. The silver will then be completely dissolved, and the gold will remain at the bottoms of the vessels in the form of powder, or in small masses of a yellowish brown colour. We wash the gold well, and reunite it in crucibles, where it is fused, adding to it a little nitre: this is what is termed gold of *depart*. To obtain the silver contained in these solutions, we pour them into large earthen vessels, and plunge into them plates of copper: this metal is dissolved in the acid, and the silver deposited in the form of crystallized masses, more or less compact, according to the greater or lesser degree of concentration of the acid. To judge when the operation is entirely terminated, we pour some drops of a solution of marine-salt, in a small proportion to that of the fluid. If it remains limpid, all the silver is separated: lastly, this powder is washed, until the water it is washed in is no longer coloured blue by the volatile alkali. We fuse the silver with a mixture of six parts of saltpetre and one part of borax. When the matter is in tranquil fusion, it is poured into an ingot-mould, which had previously been greased: when the ingot is cold, it is plunged into water, to separate the saline particles which adhere to it.

The silver which is thus obtained, when the operation is conducted with care, serves anew for *quartation*; but it

is not in the most pure state; it contains some atoms of copper, from which it is readily freed by *cupellation.*

The precipitation of the silver by the copper is effected in a longer or shorter time, which is regulated by the quantity of the fluid on which we operate, its degree of concentration, the thinness of the leaves of copper, and the temperature of the atmosphere. When we operate upon considerable quantities, we may withdraw a portion of the solution of copper; and as it contains a large quantity of water, we concentrate it in an open vessel, such as a copper basin, or, which is better, a vessel of platina. The concentrated fluid is finally put into earthen cucurbits furnished with heads, and placed in a gallery furnace; we adapt their receivers, lute the joints with clay, heat them, and distil to dryness. M. Vauquelin advises us to separate the acid which is obtained into two portions: the first which is collected serves for the process of the *depart;* the second part remaining in the retort. This *aqua fortis* is very pure, and does not need to be purified by precipitation, like that which is ordinarily sold. I believe, notwithstanding, that it contains nitrous gas, which renders it improper for the use of the assayer. We find remaining in the cucurbits a brown powder, which is the oxide of copper: to reduce it, we mix it with an equal part of black flux, and fuse it in a crucible.

Many able metallurgists have thought that the gold of the *depart* retains a little silver; and M. Lesage had shewn that this gold, dissolved in the nitro-muriatic acid, threw down a precipitate, at the end of several hours, consisting of a small quantity of muriate of silver. He also thought that the silver of the *depart* retained a small portion of gold. These ideas engaged the attention of M. Dizé, then refiner in the mint, and caused him to seek for other processes which might furnish more exact results; and, after numerous experiments, he found that the sulphuric acid offered great advantages in this respect, because that by using it he discovered in the silver minute quantities of

gold, by the means which we shall now describe. The process used by M. Dizé is brought into use, and actually employed in the large, in many establishments at Paris. When new masses of silver are brought to these refineries, they extract from them a portion of gold, which would otherwise be entirely lost. They estimate this portion at a thousandth part of the total weight of the silver, which is nearly equal in value to thirty-five thousand francs, for a thousand kilogrammes of silver. If we calculate how many thousand kilogrammes of silver are annually employed in money, commerce, and the arts, we shall be convinced of the great quantity of gold which is thrown into circulation at a total loss. The process, as now performed, consists of five different operations, which we shall now describe.

1st Operation.—Upon several furnaces, of one foot each in diameter, are placed vessels of platina, of an oval form, each of which receives about 3 kilogrammes of granulated silver, on which is poured 6 kilogrammes of concentrated sulphuric acid. Each vessel is covered by a cone of platina, having at top an opening of about 4 lines in diameter, to allow the vapours to escape. They adapt to each orifice a pipe of platina, or a tube of glass, which conducts these vapours to a condensing apparatus. These furnaces are placed under a hood, to receive and convey away the fumes, which nevertheless escape.

In the cold no action takes place; they are obliged to commence it by the help of heat, and then a portion of the acid becomes decomposed, yields its oxygen to the metal, and is transformed into sulphurous gas, which is disengaged. As the silver is oxided, it combines with another portion of the acid, and forms a sulphate, which remains in solution. The solution is brisk, and the disengagement of the sulphurous gas abundant, during the two or three first hours only: after this, the progress of the operation goes on much more slowly, and it is not until the end of about 15 hours that all the metal is acted upon.

During the whole course of this operation not only is the sulphurous gas disengaged, but also the sulphuric acid; and for this reason a much more considerable quantity is employed, than combines in the decomposition: it is therefore essential to be able to guard against the corrosive action of these vapours; and therefore they are careful to place in the funnel of the chimney a furnace, to create a rapid current, and carry them off; and we should also prevent, as much as possible, these vapours from spreading abroad; and it is very probable that means will be found to condense them. I think that, after having caused them to ascend perpendicularly, to disembarrass the workmen, it would be well to direct them laterally into a refrigerator of lead, which might condense the sulphuric acid, and allow only the sulphurous acid to escape; and even this might be easily absorbed, by making it pass through wooden vessels containing lumps of lime slightly moistened.

2d Operation.—When the sulphuric solution is finished, it is drawn off into vessels of platina, and diluted with water till it marks from 15° to 20°. We must then allow the small portion of brown powder which remains undissolved to fall down completely;—this is the gold which was contained in the silver. We decant, wash, and finally precipitate the solution of silver with plates of copper, as before described for the nitric solution. We wash very carefully the silver powder which is deposited.

3d Operation.—The silver precipitated in the preceding operation is fused in a crucible, and poured into an ingot mould.

4th Operation.—We treat the gold powder which has been separated, in the same manner, and add to it a little nitre, to free it from the small portions of copper which may still remain in it.

5th Operation.—As the sulphate of copper has many uses in the arts, it is easy to procure it from the solutions which are obtained in this new process: when

all the silver is precipitated, we evaporate and cause them to crystallize; we separate the largest crystals from the smallest, and re-dissolve the latter, to make them crystallize anew.

This is the process of refining actually in use. It remains to be shewn, however, that the advantages which it offers are attended with expenses, and that there exist in these operations certain sources of waste, which may occasion considerable losses. For example: when we fuse a mass of silver, it frequently happens that the crucible is broken, and whatever care may be taken to collect the ashes, a little deficiency is always found. Every new crucible, also, which is used, imbibes a certain quantity of silver:—in truth, all these fragments are collected, and added to the ashes from the furnaces, to be afterwards treated in the manner of reducing silver ores: but we are here again subjected to new expenses, and the whole quantity of silver is never recovered. R.

LI.—*On Reducing Friction in Machinery.*

By the EDITOR.

[Continued from Vol. I. p. 460.]

FURTHER OBSERVATIONS ON REDUCING THE FRICTION OF PIVOTS.

IT is of great importance, where the motion of revolving bodies is very swift, to cause their pivots to turn with the least possible friction. For instance, the pin-makers' steel-mills, on which the pins are pointed, make upwards of 700 revolutions in a minute, and it is therefore of the highest consequence that friction should be prevented as much as possible:—we are just informed that the conical points of their steel spindles run in holes made in pieces of the wood of the elder. Again, in the business of fine cutlery, where the same kind of spindles is used; the workmen employ the but-ends of stags' horns; the hard dense bone answering

the purpose completely. Mr. Brunel, the celebrated engineer, has found that lignum-vitæ is very effectual in reducing the friction of pivots. In metal button-making, the spindles of the burnishing lathes run with a velocity, perhaps equal to the pin-makers' mills, their necks revolving in collars of pewter, melted and cast upon them, so as to fit them exactly; and they will continue to wear for a long time, with the precaution, however, of carefully preventing the access of dust to them, which might lodge in the pewter, and act in the manner of emery, in grinding the pivots away.

We have likewise heard of large lathes, the mandrels of which carry weights of not less than a hundred pounds, such as large chucks or die-dishes, at their ends; which nevertheless turned in pewter collars with great ease, and very little friction. These mandrels, however, were very carefully made; being rough-turned in the soft state, then hardened, and tempered just enough for a hard turning tool to cut them, and thus finished: by this means avoiding all that danger of warping or cracking in hardening, which frequently takes place, after great expense and trouble have been bestowed in finishing the turning of them in the usual way.

We think, however, that it would be a still greater degree of improvement, to leave the steel necks or pivots *perfectly hard*, and finish them by turning with diamond or ruby points; in the manner practised by Mr. John Barton, of the Royal Mint.

[*To be continued.*]

LII.—*On the Uses of Albumen.**

Albumine (albumen) is a product which is found in very great abundance in the animal economy, forming the essential base of many animal fluids; such, for example, as the white of eggs, the serum of the blood, the sinovial fluid, &c.

* From the *Dictionnaire Technologique.*

This substance does not form the immediate object of any manufacture, but is of great utility in certain of the arts. Amongst the properties it possesses, we shall point out those which are most useful. Albumen readily dissolves in cold water; but heat and acids coagulate and so modify it, that it becomes totally insoluble in this vehicle. It is, nevertheless, susceptible, like other animal substances, of being combined with certain astringent and tanning matters, and to form with them insoluble and imputrescent substances. Alcohol likewise separates it from its solutions, when they are not too much diluted.

The mention of these characters suffices to shew in what manner it acts under divers circumstances in which it is employed, and more particularly in the clarifying of liquors.

When it is used to clarify a liquid which does not contain any principle susceptible of being combined with albumen, and rendering it insoluble, we have recourse to the action of heat; and in order that the albumen may act more uniformly, it is previously diluted with a small quantity of water, or of the liquid to be clarified; we then add this solution to the remainder of the liquor, and submit it to ebullition. The albumen coagulates by the augmentation of temperature; and as it is equally diffused throughout the whole mass of liquid, it seizes and entangles all the insoluble molecules, which by reason of their extreme tenuity remained in suspension in the liquid; these very minute molecules, or particles, become thickened by the addition of the albumen, and on that account it is not possible for them to pass the filters, which before would have allowed them to escape.

The same effect is produced, but for another purpose, in the cold clarifications by albumen Wine, for instance, contains a tanning substance, and acids in an uncombined state. The albumen being beaten up and combined with these principles, becomes concreted, and in its separation from the remainder of the liquid, it draws down all the

matters in suspension, giving them more density, and determining their precipitation. Clarified wine, however, sensibly loses its astringency and acidity, and also a portion of its colouring matter, which is carried down by the albumen.

The viscosity of albumen likewise renders it useful for many other purposes. Confectioners, pastry-cooks, &c. use it, to give both lightness and whiteness to certain articles. They form it into an exceedingly white froth, by agitating it briskly with small brushes or whisks. In this manner they incorporate with it a great quantity of air, which is retained or enveloped in the albumen. This froth, mixed with paste, and beaten up with it, adds lightness to it, by introducing the air which it contains; it also gives whiteness to the articles, by more minutely dividing their molecules.

In all clarifications in the small way, the albumen of the egg is mostly used; but when large quantities are operated upon, as in sugar-refining, they use the serum from the blood of the ox, when they can procure it quite fresh, as, otherwise, it communicates to the sugar a disagreeable taste.

Finally, albumen is also used as an excellent cement. In the laboratories they often cover the lutings of their apparatus with small bands of linen dipped in powdered quick-lime, and the whites of eggs. This kind of luting renders the joints impermeable to the most subtile gases. An analogous preparation is likewise used to cement broken porcelain and glass.

In addition to these important applications of albumen, we may add its great value in book-binding, as a varnish for the leather covers. And also, that a letter closed or cemented with it, is not to be opened by the steam of boiling water, as when closed by a common wafer; the heat only adding to its firmness. The white of eggs beat up with water is likewise used by sign-painters, to cover

over the oil paint with, and to prevent the leaves of gold from adhering only where gold size had been previously laid on. EDITOR.

LIII.—*On Iron and Steel. By the* EDITOR.

[Continued from p. 132.]

ON HARDENING ARTICLES MADE OF STEEL-WIRE, STRAIGHT.

THIS valuable process was employed by the late Mr. Rehe, of Shoe-lane, a most ingenious mechanic, in the following manner. The articles having previously been carefully heated to the proper degree, instead of cooling them in water, Mr. Rehe threw them upon the flat surface of a fixed block of cast-iron, and instantly rolled them round, by sliding another flat plate of iron over them; and thus, by this revolving motion, he kept them perfectly straight, in the act of being cooled and hardened between the metal plate and the block.

ON HARDENING STEEL CONICAL WATCH-ARBORS, STRAIGHT.

It has been suggested to us by Mr. Edmund Turrell, (who furnished us with the above excellent process for hardening steel-wire,) whether the Geneva watch-arbors, which are perfectly straight, although so hard as scarcely to be cut by the hardest turning tools of steel, may not be hardened by a similar process. It is true, they are of a conical form; but a circular motion might nevertheless be given to the moveable flat plate, by a little practice, suitable to their degree of taper.

[*To be continued.*]

LIV.—*On the Manufacture of Ammonia, in France.**

AMMONIA.—This is one of the longest known alkalies. In consequence of its great volatility it has obtained the several names of volatile spirit, volatile alkali, the fluid volatile alkali, volatile spirit of sal-ammoniac, and lastly,

* From the *Dictionnaire Technologique.*

on account of its being principally extracted from sal-ammoniac, a denomination derived therefrom has been given to it, and it is now called *ammonia*.

This alkali does not resemble any of the others in its composition; since, so far from being able to place it amongst the metallic oxides, we regard it as being entirely formed of azote and hydrogen. In fact, some of the most distinguished chemists have advanced, that ammonia contained oxygen, and have even determined its proportion as 20 in 100, calculating from its capacity of saturation; but, by the most direct means, it has been impossible, till very lately, to furnish positive proofs of this assertion. They have only obtained, as the result of analysis, azote and oxygen, in the proportion of one part of the former to three of the latter in volume. Thus, as they have only shewn that the one or the other of these gases, or perhaps both, are oxides, we must at least admit, that the composition of ammonia is entirely different from that of the other alkalies.

The nature of ammonia shews, that azotic substances alone might concur to its primitive formation; and, in fact, this alkali is always a product of the decomposition of animal matter. Every day this result is witnessed, and we see it exhibited wherever animal matter is accumulated. The process actually in use to effect the formation of ammonia is one immediate consequence of this observation. If we submit animal matter to the action of heat, their decomposition is such, that they form, among other products, a considerable quantity of volatile alkali.

Ammonia deprived of water is a permanent gas, of a strong and penetrating odour, and causes the eyes to water freely. This alkaline gas, which is very soluble in water, is a powerful caustic, and susceptible of forming blisters, in a very short time, upon the surface of the skin, when applied to it, and even when dissolved in water. These various properties have been successfully employed in the medical art. For instance, persons falling into swoons are

made to inhale ammonia: the strong irritation which it produces on the membranes, reanimates the spirits, and quickly restores animation. As a rubefacient, also, great advantages have been derived from it: compresses are moistened with liquid ammonia, and applied to the parts where it is wished to produce erosion; or, what is still better, (and has been recommended by Dr. Gondret,) they mix this ammonia with a fatty matter, and there results a species of soap, which, on being applied to the skin, produces a continued action, and in fact causes a blister. The great advantage of this method is in obtaining the desired effect much more quickly than with common blistering plasters; and, in urgent cases, this advantage is of great consequence. It serves also, in like manner, to cauterize, in some degree, those parts where virus or poison have been introduced, to prevent absorption; it is thus employed in the case of bites from rabid animals. And also, to remove the pain occasioned by the stings of insects, it is then, however, diluted with a large quantity of water.

Some use is also made of ammonia in the other arts. It serves to dissolve carmine, and to extract from the scales of the bleak a preparation used in the manufacture of false pearls. In chemistry it is very frequently employed, especially as a solvent of certain substances; or as a re-agent capable of demonstrating the existence of certain bodies, in what way soever they may be combined. Many metallic oxides are soluble in ammonia, and we are thereby furnished with the means of separating them from such as do not possess the same property. All the salts of silver (the prussiate excepted) are soluble in this alkali: the chlorate of silver is also dissolved in it with such facility, that thoughts have been seriously entertained of substituting this means for the process of amalgamation in working silver-mines, especially those of Peru and Mexico, where so large a quantity of mercury is lost, not only in consequence of the length of time employed in this process, but also as, on account of the want of powerful combustibles, they are

obliged to avoid the roasting process, and are forced to act on a greater mass of mineral, or at least on a mineral which is not very rich in ore. The expenses incurred by the waste of mercury are also considerable; for which reason it has been thought more economical to dissolve the chlorate once formed, in ammonia—an experiment which they are incessantly making. This solution allows the chlorate to be deposited by one simple evaporation. They can also at once separate the silver in a metallic state, by plunging into it plates of copper, which is substituted for the silver.

Ammonia not having any very strong affinity for acids, it is easily displaced from all its saline combinations by most of the bases: some, however, such as magnesia, are only decomposed in part, and partaking of the nature of the acid, combine with it to form a double salt; but this is a rare case, and generally the decomposition is complete. Thus, not only potash and soda, but also lime, barytes, and strontian, and even many metallic oxides, separate the ammonia when mixed with any salt forming its base. There is, then, no want of means by which volatile alkali may be procured; economy alone must determine the choice of materials. In laboratories, and even in manufactories, they use for obtaining it a mixture of quick-lime slaked with water, and pulverized sal-ammoniac. If they wish to collect it in the state of gas, they employ the caustic anhydrous lime, and operate with mercury, in the same manner as with all other elastic fluids which are soluble in water. To obtain liquid ammonia, they use a common Woulfe's apparatus, composed of an earthen retort, and a series of three or four bottles, furnished with tubes of communication and safety-tubes. When the quantities operated upon are considerable, either a pot or a cylinder of cast-iron is employed instead of a retort, to which is adapted an apparatus of a relative capacity: sometimes they use simple vessels of stone-ware, which they dispose in the same manner as for the manufacture of the hydrochloric acid. The operation is commenced by dividing the lime with the assistance of

a little water; for which purpose it is sufficient to put small pieces of lime into an earthen pan or wooden tub, and sprinkle a little water gradually on all their sides. This is continued until all the lime is properly slaked; it is then left to cool, and passed through a sieve. Some manufacturers recommend the employment of the anhydrous lime, which they simply pound in a mortar; but there are disadvantages attendant upon this method:—the labour is considerably increased, and the operation is also very disagreeable to support; besides which, the lime never attains the same degree of division. Finally, the most decisive reason is, that the presence of water in the lime renders the decomposition infinitely more easy; it serves as a vehicle for the gas, and it is drawn off with much greater rapidity. With respect to the sal-ammoniac, it may be pulverized by the ordinary means. They then make a mixture of equal parts of these two substances, which they introduce either into a retort or a cylinder, according to the quantity, taking care that the vessel be not completely full. Frequently, to prevent being so much annoyed by the powerful odour which is disengaged from it, they do not mix it all at once.

The first materials being thus prepared, they adapt to the retort or cylinder an apparatus, all the parts of which ought to be properly fitted beforehand. By means of a large bent tube they adjust the first bottle, which is designed to wash the gas; that is, to free it from all extraneous matters. To this first bottle, into which is put a very small quantity of water, and which is furnished with a tube of safety, they adapt a second, and then a third, and divide between the two a quantity of water, nearly equal to the whole of the salt employed, taking care that each bottle be left at least two-thirds empty. These precautions being taken, they carefully lute all the joints, and then cover the furnace with its dome. The cast-iron cylinders which are used in extensive operations of this sort, have at one of their extremities a tube to communicate with the Woulfe's

apparatus. The opposite side, or that by which the charge is introduced, and the residuum removed, is furnished with an iron quadrangular frame: to this frame they fit a square plate, and secure it by means of screws and nuts, previously placing a small ring of felt between the two surfaces: the joints are then covered with a mixture of moistened furnace-earth, a little marine salt, and cut tow; and finally, they again surround these lutings with moistened argillaceous earth, to preserve their humidity, and prevent them from cracking. This operation, even on a large scale, requires more care than others of a similar nature, because that pressure which the lutings must resist cannot be avoided. It is not the same in many other cases. Thus, in the manufacture of hydrochloric acid, for instance, they content themselves by making the gas arrive at the surface of the water; because its solution being much more dense than the water, it immediately falls to the bottom of the vessel, and, till the whole be saturated, the water is always uppermost: whilst it is precisely the contrary with the ammoniacal gas; for its solution in water is lighter than the water itself; and consequently the gas rising to the surface of the water, soon finds itself in contact with a saturated layer: this prevents the saturation of subsequent layers; and it is then absolutely necessary either frequently to agitate the liquid, or to plunge the tubes for conveying the gas deeply into it; and in this last case, the lutings have a very great pressure to sustain, and it thus frequently happens that they cannot resist it. Now, supposing the apparatus to be properly adjusted, they commence by heating it, and immediately perceive the gas to be disengaged; the greater or less rapidity of its emission serves as a guide to augment or diminish the fire. As the gas dissolves, the volume of the liquid increases; and its temperature is raised in a much greater proportion than the quantity of gas dissolved in a given time would have led us to expect. The change of the volume explains itself; and it is conceived that the elevation of temperature is owing to the elastic fluid

abandoning its aëriform state, to be converted into a liquid; and, consequently, it must lose all that portion of latent heat which it retained in the state of gas.

A period however arrives, when, notwithstanding that the current of gas is supposed to be always the same, the liquid nevertheless cools; because, being then near to its point of saturation, its dissolving power becomes less and less; and because a portion of the gas passes into the succeeding bottle, there to be dissolved, and to produce (as before explained) an augmentation of temperature and volume. The operation proceeds thus, till the complete decomposition of the sal-ammoniac takes place, and they perceive that it is nearly completed, when the tube of communication from the retort becomes extremely hot, and a great quantity of liquid begins to condense in the first bottle. This phenomenon is due to the humidity of the lime and the salt, which is dissipated towards the end; and probably also to the combination of the hydrogen of the hydrochloric acid with the oxygen of the lime. At this period also, a little inflammable gas is sometimes disengaged, greatly resembling the decomposition of a portion of ammoniacal gas, when exposed to a very elevated temperature. When arrived at this point, the apparatus is allowed to cool, and is then unluted.

As a residuum, there is found a mass of a fawn colour, compact, and so hard that it emits sparks under the stroke of a hammer. The interior presents a brilliant and laminated fracture: these plates tarnish on exposure to the air, because they attract humidity. Treated with water, this residuum does not entirely dissolve, one part of the uncombined lime remaining upon the filter. The liquor evaporated to a certain degree of concentration, affords, on cooling, crystals resembling those of boracic acid, which have been taken for a sub-hydrochloriate of lime, and which I can readily believe to be the deutoxide of calcium—at least it bears the same characters: but as these crystals are formed in the midst of an extremely viscous liquor, and are likewise very

liable to change, they have never succeeded in separating them completely from the muriate of lime with which they are surrounded. It is, however, believed, that they contain in their composition a certain quantity of hydrochloric acid.

With regard to the liquid products, we must reject those of the first bottle, being coloured, impure, and excessively weak, because the steam of the water which rises towards the end of the operation is so cold that it scarcely dissolves the gas. The second bottle is generally the most saturated: the volume of water which it at first contained is augmented about one-third, but its density is singularly diminished. In commerce, they estimate its value according to its density, by means of the areometer for spirits. The ordinary liquid ammonia generally marks from 20 to 22°: it may be raised to 24 or 25°; but in summer particularly, it is extremely difficult to preserve it at this point of concentration. For experiments which require the greatest degree of exactness, we must rigorously determine its specific gravity. Sir Humphrey Davy has calculated the following table, in which he has determined the proportions between the water, the quantity of gas dissolved, and the specific gravity of the solution.

Specific Gravity.	Ammonia.	Water.
0,9054	25,37	74,63
0,9166	22,07	77,93
0,9255	19,54	80,46
0,9326	17,52	82,48
0,9385	15,88	84,12
0,9435	14,53	85,47
0,9476	13,46	86,54
0,9513	12,40	87,60
0,9545	11,56	88,44
0,9573	10,82	89,18
0,9597	10,17	89,83
0,9619	9,60	90,40
0,9684	9,50	90,50
0,9718	7,17	92,83

When we employ ammonia as a re-agent, it is necessary that it should be of the greatest purity; but that which is met with in commerce, and as prepared in the manufactories, is far from having the requisite qualities. Many circumstances prevent this: on the one hand, they do not use distilled water for this object; and on the other, to avoid a too great pressure in the apparatus, they do not use the vessel to wash the gas in. Sometimes, also, the materials which they employ are not of the best quality. In fact, in this manufacture they use a part of the waste and pieces of the loaves of sal-ammoniac, &c. Hence the ammonia of commerce always contains sal-ammoniac and other particular salts in the water which they use, and likewise a variable quantity of empyreumatic oil. We can easily detect the presence of all these bodies, by means of the well-known re-agents; as, the barytic salt for the sulphates, and the nitrate of silver for the muriates: but in the last case we must take the precaution, before we pour in the nitrate of silver, to saturate the ammonia with pure nitric acid; otherwise it would not precipitate, even when the ammonia contains much hydrochloric acid, because it has the property of dissolving the chlorate of silver. As to the empyreumatic oil, if we have not recourse to the smell in judging of it, we must dilute the alkali with water, for the purpose of attenuating the odour which is peculiar to it, and to be able the better to distinguish the other. We may also employ another method, which consists in adding an equal volume of concentrated sulphuric acid; the oil is then carbonated, and the mixture becomes blackened.

Ammonia, either liquid or gaseous, possesses many properties which we have not mentioned, because they have no direct connection with our object: but we must not conclude this article without pointing out the means of being assured of the composition of this alkali. Scheele was the first who perceived that it contained azote; and after him Priestley discovered in it hydrogen, by submitting it to the action of electricity; and in 1785, M. Berthollet determined,

by a close examination, the relative proportions of the two elements which compose it. He placed in an eudiometer over mercury a certain volume of ammoniacal gas, and an equal volume of hydrogen; the electric spark exploded the hydrogen, whilst the azote, mixing with the excess of oxygen, formed the residuum. If we take two-thirds of the absorption occasioned by the formation of the water, as the quantity of hydrogen, the remaining third gives the combined oxygen. This third, subtracted from half the volume employed, gives precisely the oxygen which forms part of the residuum. This new quantity, subtracted in its turn from the total residue, furnishes the quantity of azote. It thus appears that 100 parts of ammonia in volume, are formed of 150 of hydrogen, and 50 of azote; or, with regard to the specific gravities of these two elements, of 21,15 of the first, and 100 of the second.

The composition of ammonia being well known, shews how it seizes the oxygen from certain easily reducible oxides; and also how it acts on certain bodies which have a strong affinity for hydrogen, such as chlorine, iodine, &c.

R.

LV.—*On Polishing Hard and Soft Wood, whether Plain or Engine-turned, in the Lathe; and also Ivory, Bone, Horn, Tortoise-shell, Jet, Brass, Iron, and Steel;—and on Varnishing or Lackering. By Messrs.* Holtzapfel *and* Deyerlein, *of London.*

We gladly avail ourselves of the kind permission granted us by the above celebrated lathe and engine manufacturers, to lay before our readers the following processes, which are the result of great practical experience.

DIRECTIONS FOR POLISHING IN THE LATHE.

Good work does not require much polishing, for the beauty of it depends more on being executed with tools properly ground, set, and in good order: the work per-

formed by such tools will have its surface much smoother, its mouldings and edges much better finished, and the whole nearly polished; requiring, of course, much less subsequent polishing than work turned with blunt tools. (This is often the case in that done by amateurs and workmen who have not proper conveniences for grinding and setting their tools.)

One of the most necessary things in polishing is cleanliness: therefore, previous to beginning, it is as well to clear the turning-lathe, or work-bench, of all shavings, dust, &c. as also to examine all the powders, lackers, linen, flannel, brushes, &c. which may be required; to see that they are free from dust, grit, or any foreign matter. For further security, the polishing powders used are sometimes tied up in a piece of linen, and shaken as through a sieve, so that none but the finest particles can pass.

Although, throughout the following methods, certain polishing powders are recommended, for particular kinds of work; it must be understood, that there are others applicable to the same purposes, the selection from which remains with the operator; only observing this distinction, that when the work is rough, and requires much polishing, the coarser powders are best; but, on the contrary, the smoother the work, the less polishing it requires; consequently, the finer powders, in the latter case, are preferable.

Directions for Polishing.

soft wood.

Soft wood, though nearly the most difficult material, may be turned so smooth, as to require no other polishing than that produced by holding against it a few fine turnings or shavings of the same wood whilst revolving, this being often sufficient to give it a finished appearance: but when the surface of the work has been left rough, it must be rubbed smooth with polishing-paper, constantly varying the position of the hand, otherwise it would occasion rings or grooves (if they may be so called) in the work.

When the work has been polished with the lathe revolving in the usual way, it appears to be smooth; but the roughness is only laid down in one direction, and not entirely removed, which would prove to be the case by turning the lathe the contrary way, and applying the glass-paper; on which account work is polished best in a pole-lathe which turns backwards and forwards alternately; and therefore it is well to imitate that motion as nearly as possible.

MAHOGANY.

Mahogany is polished with bees-wax dissolved in spirits of turpentine to the thickness of honey. This should be applied very sparingly on a piece of flannel, and afterwards as much of it rubbed off as possible with a clean flannel; for if any perceptible quantity remains on, it is sticky and unpleasant.

HARDWOODS WITH POWDERS.

The work being turned smooth, and prepared with polishing-paper, take some yellow tripoly and oil, on a piece of flannel or linen, which is used in the same manner as glass-paper, producing a beautifully smooth and polished surface.

As a general rule, it must be here observed, that all powders become finer by wear, in proportion as they polish the work to which they are applied, and consequently give a greater brightness; therefore, it is adviseable never to add fresh powder in the course of the operation, if it can be avoided; but to use the same throughout, which gets gradually finer as the work advances.

Box, and other light-coloured woods, ought never to be polished with any darker powders than yellow tripoly; as they sometimes fix themselves in the grain of the wood, and discolour it.

HARDWOODS WITH DUTCH RUSH.*

All the knots being first cut off, the rushes, tied in a

* Dutch rush and water can only be used on such woods as will not become discoloured by them.

small bundle, are applied to the work with water, the hand being constantly moved, to produce an even and regular surface. The same may be said of rush as of polishing-powders; that in the course of use it becomes finer, as from a coarse to a finer file. When the operation has been continued till the rush seems to have no more cutting quality, both the work and the rush are suffered to dry perfectly, and the polishing is then finished with the same rush, but without water.

HARDWOOD ORNAMENTED OR ENGINE-TURNED.

The polish of all ornamental work wholly depends on the execution of the same, which should be done with tools properly sharpened; and then the work requires no other polishing but with a dry hard brush, to clean it from shavings or dust, this trifling friction being sufficient to give the required lustre.

IVORY, PLAIN.

Ivory is prepared for polishing by rubbing it with powdered chalk, Highgate loam, Flanders' brick, or Trent sand, and water, applied upon a woollen cloth, to get out all the scratches or tool-marks. It is polished with putty-powder and water, or whitening and water, mixed to the consistency of paste; it is used with linen or buff-leather, and applied as the tripoly before described. When the work is perfectly smooth, it is cleaned with water, or a few ivory turnings; the final polish is given with a very small quantity of tallow or oil, on a piece of clean linen.

Some persons suppose that applying any unctuous substance causes the ivory to turn yellow; but the quantity used need be trifling, and as the greater part of it is again rubbed off, no such effect can occur.

IVORY, ORNAMENTED.

This is polished with the same materials as when plain;

but a clean brush is substituted for linen, which penetrates the cuts of the work.

When this has been done as long as is thought necessary (which a very little practice will determine), the whitening must be washed off with clean water and a brush; then remaining till perfectly dry, must be finished with a clean dry brush. Sometimes a small portion of sweet-oil is put on the finishing brush, but that is optional.

Ornamental work should be polished as little as possible, as the sharp edges, which constitute its greatest beauty, are thereby in danger of being destroyed.

BONE.

This is to be prepared and polished exactly in the manner of ivory.

HORN.

Horn may be prepared for polishing in a similar manner to ivory; it is polished with tripoly and oil, the same as hardwood: if this is not found sufficiently brilliant, its polish can be increased by rotten-stone and oil, applied on soft linen or buff-leather; and, lastly, with the same powder quite dry, or with the palm of the hand.

TORTOISE-SHELL.

Tortoise-shell, after having been prepared for polishing in the same manner as ivory, is polished with tripoly, or crocus and oil, applied upon linen, buff-leather, or flannel, and afterwards with rotten-stone. The final lustre is frequently given by the last-named powder, dry, with the palm of the hand.

JET.

Jet is polished in the same manner as tortoise-shell.

BRASS, AND SIMILAR METALS, TURNED.

For these, emery-paper is used; pumice-stone finely

pulverized is sometimes used with water, on cloth; crocus and oil is afterwards applied, also on cloth. For the final polish, rotten-stone is best, which gives the work the black lustre so much admired. Tripoly is sometimes used instead of crocus and rotten-stone; but, being coarser than either of the former, it is only fit for large work, such as stoves, fenders, &c.

BRASS, &c. (FLAT WORK).

Pumice-stone, charcoal, and bluestone, in the lump, are rubbed on the surface, with water.

Crocus and rotten-stone are applied on sticks of mahogany, or on similar woods; or on sticks covered with thick buff-leather.

Washed flour emery is sometimes used after charcoal: this does not produce so bright a polish as rotten-stone, but it lays the grain, which is sometimes preferable.

Work is also polished with a circular brush on a spindle, which revolves between two centres, as in a grinding machine or lathe; the brush is supplied with crocus and oil.

IRON AND STEEL (TURNED WORK).

These metals are mostly polished with emery, which is applied on the end of a piece of soft wood, in the shape of a chisel, but much thicker. The end thus cut is dipped into emery mixed with oil, and held tightly against the work; by which means a polish will be produced, in proportion to the fineness of the emery and the friction thus employed. Fine emery will polish the iron or steel well enough for most purposes; but crocus, used as emery, gives an additional brilliancy.

Iron and steel screws ought to be polished in the way just described, to remove the roughness left from the die-stock, &c. and the screws will wear the better.

Oil-stone powder is mostly used for grinding and fitting together.

IRON OR STEEL (FLAT WORK).

This is also polished with emery, but then it is glued on

sticks of deal of various shapes. Some persons use emery-paper folded round a file, or piece of wood shaped suitably to the work. Crocus, when used in flat work, is mostly applied on a square piece of mahogany, without being fastened with glue. It can also be used with a buff-stick if required.

Directions for Varnishing and Lackering.

SOFT WOOD.

The work being perfectly dry, and free from oil or grease, apply white varnish or lacker, with a fine brush (but not of camels' hair); permit it to dry, and give five or six coats or more if the wood is soft and absorbs the varnish. When the work is covered with a perfect coat, and quite dry, the surface of the same must be polished with a little sweet-oil and whitening, taking care not to heat it by friction whilst polishing; as that would occasion a blistered or uneven surface, and spoil the whole. If not perfect, apply the varnish again, and proceed as before.

If a hair of the brush, or any dirt, settles on the work whilst lackering, it must be removed before the varnish is dry; otherwise it cannot be taken off without injury. The process of lackering should be performed in a warm room.

HARDWOODS.

Take a small quantity of hardwood varnish or lacker*, and about one-third as much sweet-oil, on a piece of clean linen; applying the oil to the linen before the varnish: then, with a quick motion and light friction, rub it on; the hand continually altering its position, until the lacker is dry; if not sufficiently bright, the lacker may be repeated once or twice, but very sparingly.

Wood, when polished endways, absorbs much more varnish than when polished sideways or lengthways; and, it being necessary that the operation should be continued until the pores of the wood are filled up, it renders it rather a difficult operation. Mahogany can also be varnished with

* For the preparation of this, see our Article, "*On the French Varnish or Polish.*" Vol. I. p. 354.

hardwood lacker; in which case, however, no bees-wax must have been previously used.

BRASS, &c.

The brass, being previously polished, must be made as warm as steam would render it: but although steam is mentioned as a criterion for the heat required, yet it must not be understood that the work should be exposed to the immediate action of it, as it would require freeing from the moisture occasioned by the steam, before the lacker could be applied. But if the brass could be heated on the top of a vessel in which steam is constantly forming, or through which it has a passage, and is conveyed away from thence by a pipe, so as not to be able to affect the work, it would be a very clean and effectual method. In the large way of lackering, the brass-work is heated upon a stove. The work, being properly heated, must be wiped over with a piece of clean linen and whitening: the lacker is then applied with a brush; but only in one direction, and not backwards and forwards, as in painting. If one coat is not thought sufficient, a second or third can be added.

There are two kinds of brass lackers, the pale and the high-coloured*: they are both applied in the same way; but the latter contains more lac than the former, and is mostly used for brass-work or furniture.

LVI.—MISCELLANEOUS.

On the Improved Communication with Ireland.

EIGHTEEN miles of the new road through Anglesea has been opened since the 1st instant—namely, that part which is next to Bangor Ferry. It avoids all the hills, passes close to Lord Anglesea's Column, and for the last two miles presents a most magnificent view of Plasnwydd and the Menai Straits. The old road, for the first five miles

* For the preparation of these lackers see our Article, "*On Gold Coloured Varnishes & Lackers.*" Vol. I. p. 231.

from Holyhead, is still travelled; but there are five hundred men now employed at the embankment over Lady Stanley's Sands, and the whole of the Anglesea road will be finished by Christmas. It saves, altogether, better than three miles. The new inn built by Colonel Sparrow, and which is just twelve miles from Holyhead, is finished, and now inhabited by Mr. Moulsdale, the former occupier of the old Gwyndee Inn. Some delay has been occasioned by the bad weather of last winter in building the Menai bridge, from the difficulty of bringing stone. It is now proceeding with great rapidity: all the arches are finished on the Caernarvonshire side to the level of the roadway; those on the Anglesea side are proceeding rapidly, and will be finished in about a month. The caverns, or recesses in which the iron cables are to be placed, are finished on both sides. The Pyramid on the Caernarvonshire side is begun: the iron cables are nearly all made; they are the work of Mr. Heseltine, the celebrated iron-founder of Shrewsbury. The bridge will be opened about this time twelvemonth. The Conway bridge is also proceeding with great rapidity. The abutments for the Chain bridge, between the island and the main land, are finished; and the embankment is in a state of great forwardness. This bridge will be completed about the same time as the Menai bridge. The increased postage on letters will form an ample fund for the building of this bridge; it is therefore intended to allocate the tolls of it towards forming a road round the base of Penmen Mawr, Pont Sychmant, and Pannaer Ross, by which all the hills between Bangor and Abergelle will be avoided.

The steam-packets to Liverpool and Bristol have injured the travelling through Wales very much. The passage from Dublin to Holyhead is performed generally in from six to seven hours—that to Liverpool, in from twelve to sixteen hours—that to Bristol, in from twenty-seven to thirty-three hours. The mail is about eight hours longer in going from Holyhead to London, than from Liverpool to

London. It is a fact, that numerous persons going from Liverpool to Bristol, proceed by Dublin. The expense is the same; and they are only a day longer on their route, with the advantage of visiting Dublin. Most of the Scotch, especially from Glasgow, in proceeding to Bristol or the West of England, come in the steam-packet to Belfast, from thence in the coaches to Dublin, and from thence, in the St. Patrick steam-packet, to Bristol.

On the successful Application of the Epicycloid to the Teeth of Spur Wheels; and on Fire Boxes. By a CORRESPONDENT.

SIR, *Halifax, Yorkshire, Aug.* 13, 1822.

HAVING been a purchaser of your valuable work, The TECHNICAL REPOSITORY, since its commencement, permit me to make the following request, which is not merely my own, but also that of three other persons, who are purchasers of your work. The persons above alluded to, are *master millwrights and iron-founders, who have applied your method of the formation of the teeth of Spur Wheels* (as published in Imison's work), *with the greatest satisfaction.* Since which time they have been desirous of applying the Epicycloid to the formation of the teeth or cogs in *bevel geer* also; and, as it is stated in Volume I. page 344, of your work, that the form of the teeth in bevel geer should be partly radii and partly epicycloidal; a plate, descriptive of the best method of applying the epicycloid to bevel geer, would be highly acceptable. Should you think proper to gratify a few of your subscribers in the above request, you will confer a great obligation on the above respectable individuals, and also upon,

Sir, your obedient servant,

T. GILL, *Esq.* R. H. B.

P. S.—Permit me to observe, the use of the sulphuric acid bottle,—which is treated of in your work, on the subject

of making the oxygenated matches,—in this part of the country is entirely done away with, by substituting a piece of cork, or such like substance instead. The cork is fastened inside the lid or top of the tin box which contains the matches, and appears to be rubbed on the surface with some material to create or augment the friction when the end of the match is rubbed thereon. This application of the cork appears to be an improvement worthy of notice; as it does away with the danger attending the acid bottle (or rather the use of it), by damaging the apparel of those who use it; and it is also a small saving of expense.

It is our intention, in the continuation of our article "*On reducing Friction in Machinery*," to describe the method of applying the epicycloid to the teeth of bevel wheels and pinions.

We apprehend that the matches alluded to in the postscript of our Correspondent's letter, have first been dipped into a *phosphorus* bottle; and are afterwards ignited by rubbing them upon felt, cork, &c. in the manner now commonly practised in France.—EDITOR.

Improvements in Pedal Harps.

MR. DODD, of St. Martin's-lane, has lately made some very considerable improvements in the construction of these elegant instruments. It is well known that owing to the crooked form of the neck, where it joins the body of the harp, it is quite impossible to procure wood with its grain running in that direction which its shape requires: the consequence is, that it is *cross-grained*; and, accordingly, harps very frequently break in that part. Mr. Dodd has completely remedied this evil, by forming the necks of his improved harps of a number of layers of wood firmly combined, and bent into the required shape. He has also effected other improvements in the construction of the

body of the instrument, so as considerably to increase its strength: and also in the manner of stringing it; whereby, in putting on or taking off any string, the adjoining one is not put out of tune, as is generally the case in harps strung in the usual manner. Mr. Dodd has secured these various and important improvements by a Patent.

Improved Life-Preservers from Shipwreck.

Mr. Scheffer (the inventor and patentee of the Penographic Writing-Instrument, or an improved Fountain Pen) has recently applied his ingenuity to the forming of a Life-Preserver of a new material. The shape of this apparatus is that of a hollow circular and cylindrical belt or ring, which surrounds the upper part of the body of the wearer, and keeps itself in its place without the use of straps, so that it may be slipped on in an instant. It is formed of several thicknesses of animal membrane cemented together, and is entirely without seam; it is made air-tight and water-proof by being varnished and painted. It has a pipe and stop-cock, by which it can be inflated with air in the short space of one minute; and it will then support the weight of two persons in the water, in cases of emergency. When emptied, by pressing out the air, it is remarkable for its lightness and portability, and it is capable of being packed in a very small space indeed. When intended to be worn by females, it is made to open in front, so that it may be slipped over their shoulders, and springs close again by its own elasticity, to surround the body and support it in the water. These advantages render this Life-Preserver highly deserving of adoption; and we trust that the approbation of the public will repay the inventor for his meritorious labours. We understand that he does not intend to secure a monopoly of his invention by patenting it, being quite satisfied that the difficulty of constructing it will render it unlikely that any other person will rival him in the manufacture of them.

Improved Shower Baths.

An important improvement has been lately effected in these useful appendages to the health and comfort of the community, by Mr. Feetham, of Ludgate Hill and Oxford-street, which consists in affording the means of adjusting the shower of water to the feelings of the party using the bath; so that it may be increased or diminished at pleasure, and the violent shock generally occasioned by shower baths rendered completely optional.

By this important regulation, this shower bath may be used by persons of the tenderest age or most delicate habits and constitutions, either as a medical or pleasure bath. This invention is secured by Patent.

On the Bélier Hydraulique, or Water-Ram.

We were much amused lately, in learning from Mr. Collier the incident which afforded M. Mongolfier the first idea of constructing this machine. Walking along the sea-shore, he was much surprised at finding a spring of *salt water* issuing from the rocks, at a considerable height above the surface of the ocean. This induced him to enquire into the cause of such a singular effect; and on descending, he found that the waves beating violently against the base of the rocks, forced the water into the cliffs at each successive stroke; and this, aided by the capillary attraction, occasioned the phenomenon.

On considering this effect, he was led to endeavour to construct a machine which should produce a similar result. With this view, he made a vast number of experiments; and, in conjunction with the late Mr. Boulton of the Soho, near Birmingham, he patented many different modes of carrying his invention into effect. This Patent has long expired; and we do not know that any of the methods published therein, have been attended with any beneficial results in this country. Latterly, however,

the difficulties formerly experienced seem to have been overcome; and we have just heard that Lord Ducie has two of the machines in use at his seat near Minchinghampton, in Gloucestershire, constructed under the direction of Mr. Collier; and a Mr. Easton has just opened an establishment in the Strand, opposite to Norfolk-street, for the sale of them, under a Patent, which he has obtained within these four years, for improvements made by himself, in the manner of continually supplying air to them, in order, by its elasticity, to break the shock of a body of water suddenly stopped when in motion, upon the surrounding parts of the machinery, and also to maintain a constant stream from the pipe whence the water issues. These improvements seem completely to answer their intended purpose, as appears from several most satisfactory certificates in the possession of Mr. Easton, from gentlemen in the country of the highest respectability, who have these machines. One of these certificates, in particular, states that the machine erected by Mr. Easton has been in constant use, without needing any repairs, *for upwards of two years.* We may therefore now entertain the hope, that these simple, cheap, and useful machines will come into general use amongst us. Mr. Easton has one erected upon his premises in the Strand, which raises the water to the height of sixty feet, with a fall of ten feet: but the machines are capable of raising water to the elevation of upwards of two hundred feet, with proportionate falls to actuate them. And we are informed, that in France, several towns are actually supplied with water by means of these machines.

LIST OF PATENTS FOR NEW INVENTIONS,

which have passed the Great Seal, since July 27, 1822.

To Jonas Hobson and John Hobson, of Mythom-Bridge, in the parish of Kirkburton, in the county of York, woollen-manufacturers and merchants; for a new series

of Machinery, for the better, more effectual, and expeditious mode of shearing, cutting, and finishing Woollen Cloths, Kerseymeres, and all other description of Cloths and Piece-goods, which require the use of the Shears. Dated July 27, 1822.—To be specified in two months.

To John Stanley, of Chorlton Row, within the parish of Manchester, in the county of Lancaster, Smith; for certain Machinery, calculated for a more efficacious mode of Fuelling, or supplying of Furnaces in general with Fuel; whereby a considerable reduction in the consumption of fuel, in the appearance of smoke, and of labour is effected. Dated July 27, 1822.—In six months.

To John Pearse, of Tavistock, in the county of Devon, Ironmonger, and Clock and Watch Maker; for certain improvements in the construction and manufacture of Spring Jacks, and their connection with roasting apparatus. Dated July 27, 1822.—In six months.

To Sir Anthony Perrier, of the city of Cork, Knight; for certain improvements in the apparatus for distilling, boiling, and concentrating, by evaporation, various sorts of Liquids and Fluids. Dated July 27, 1822.—In six months.

To Robert Roxby, of Arbour-Square, Stepney, in the county of Middlesex, Gentleman; for certain improvements on, or additions to, the astronomical instrument known by the name of the Quadrant. Dated July 31, 1822.—In two months.

To William Cleland, of the city of Glasgow, in North-Britain, Gentleman; for an improved apparatus for the purpose of evaporating Liquids. Dated August 17, 1822. —In four months.

ERRATA.

Page 89, line 11, for *citrate*, read *tartrate*.
92, line 18, for *nitre*, read *nitric acid*.

THE

TECHNICAL REPOSITORY.

LVII. — *Description of an improved Saw Machine, with Sectional Teeth, for the purpose of manufacturing Pipe and Barrel Staves and Heading; and Feather-edged Siding, or Weather-boarding: with Remarks on the Machine, and the Timber manufactured by it.* *By* ROBERT EASTMAN, *of Brunswick, Maine**.

[Communicated by Professor Cleaveland, of Bowdoin College.]

WITH A PLATE.

THIS machine consists of a frame, about twenty-four feet in length, and five in breadth; and a carriage about twelve feet in length, and four in breadth. The carriage travels with iron trucks, grooved on their circumferences, which run upon iron slides, bolted to the inner sides of the frame. An iron centre passes through one end of the carriage, and has a dog, which is driven into the end of the log, and is one of the centres on which it revolves. At the other end of the carriage, *where there are two cross pieces*, is an iron arbor, which *receives the circular iron dividing plate*, with concentric circles of holes drilled through it, at equal distances, and corresponding to the different sizes of the logs, to be manufactured into staves, heading, or siding. These holes are called the numbers of the plate. On the end of the dividing plate arbor, inside of the carriage, is a square to receive a dog, fitted to it, which is first driven into the end of the log, and then slipped upon the square of the arbor, by means whereof, the arbor, dividing plate,

* From Professor *Silliman's American Journal of Science and Arts.*

and log are firmly connected together, and both revolve on the arbor and centre, which are kept in place by stirrup-screws.

Near the middle of the frame is the main shaft, which is of cast-iron, and runs upon friction rollers, supported upon stands on the floor; and which stands are made to rise and fall, to accommodate the saw to the varying thickness of the logs to be cut. On this shaft are fixed the saw and sappers, which are firmly attached to it by screws. The sappers are crooked pieces of iron, *steel-edged*, with slits in them, to set them at a greater or lesser distance from the centre of the saw, according to the width of the timber to be manufactured; and, partaking of the common motion of the saw, *although at a less distance from its centre*, cut the sap off the log, leaving the thick or outer edges of the timber perfectly straight.

A band, passing round the main pulley, which is on the main shaft, and round a drum, which runs underneath it, (*which may be driven by horse, steam, or water power,*) gives motion to the saw, and sets the machine in operation. The saw has only sectional teeth, and is made of a circular plate of sheet iron or steel, about one-eighth of an inch in thickness, containing usually but eight teeth, which are set in the outer edge of the saw-plate, being dovetailed and grooved, in order to remain firm until worn out, when new ones may be set in the same plate.

Under the frame is a small shaft, with a large pulley on it (inside of the frame), which is connected with the main shaft by a band: on the other end of this small shaft, at the outside of the frame, is another small pulley, which is also connected by a band with the *feed-pulley*, which is placed upon a moveable lever, near the middle of the frame. On the inner face of this *feed-pulley*, are two toothed wheels; one of them contains eight cogs or teeth; this is placed in the centre; the other is a ring with teeth inside it, pointing to the centre, and having fifty cogs. Another short shaft, with two toothed

wheels fixed upon it, each containing about eighteen cogs, is fixed near the middle of the frame. One of these latter wheels acts in the toothed rack, fixed underneath the carriage; the other, which is fixed on the outer end of the shaft, is acted upon alternately, by the larger or smaller toothed wheels of the *feed-pulley*, so as to cause the carriage and log upon it to advance towards the saw, or to recede from it alternately, by the different actions of the eight-toothed and the fifty-toothed wheels, on the cog-wheel with eighteen teeth; which not only reverses the motions, but at the same time gives a different speed to the travel of the carriage, in its advancing towards, or receding from, the saw. Thus, when the eight-toothed wheel acts in the eighteen-toothed wheel, the carriage moves forwards with a slow motion towards the saw: when the cut is performed, the *feed-pulley* shaft drops, and disengaging the eight-toothed wheel from the eighteen-toothed one, engages the latter with the ring of fifty teeth, which reverses and quickens the travel of the carriage, in receding from the saw, in the proportion of fifty to eight. This motion of the rising and falling of the *feed-pulley*, is effected in the following manner:—The lever, carrying the *feed-pulley*, has a small hooked steel spring at each end of it, which catch or lock alternately, on pins fixed in the side of the frame, to hold or retain the toothed wheels in action, when the carriage is either advancing or receding. In the centre of the lever is a pin or stud, by which it is attached to the side of the frame, and upon which it turns. On the top of this lever two wooden springs are fixed, which proceed from its centre to each end of it, rising upwards, so as to form inclined planes.

A projecting piece on the underside of the carriage, presses upon the rising ends of these wooden springs, as the carriage advances or recedes, and alternately unlocks the steel springs from the pins in the frame; and the wooden spring causes that end of the lever upon which the projecting piece presses, to descend, and the other end to

ascend, and lock its steel spring on the pin in the frame again. The piece of wood which supports the *feed-pulley*, is attached to that end of the lever which is in the middle of the frame, and causes it to ascend or descend at every alternate movement of the carriage. An iron frame is bolted firmly on the end cross-piece of the carriage, which holds an iron hand with a steel point in it, which, by means of a steel spring, locks into the holes in the dividing plate, and keeps the log firm in its place, whilst the saw is performing its cut.

On the inside of the end cross-piece of the frame is a shifting iron, which is a horizontal bar of iron, with an elbow, forming an acute angle on the outer end; on the inner end is another elbow, which turns down, forming a right angle, with a bar perforated with screwed holes, at suitable distances, to correspond with the circles of numbers in the dividing plate: into the holes in the bar, a steel point, seven or eight inches in length, may be screwed, so as to enter any of the circles of holes in the dividing plate. This iron can move horizontally, being supported with hook bolts, and is kept in place by a small spring, acting on the inner end; and two guard screws are set, so as to guide the large point into one of the holes in the dividing plate, when the carriage and log return from the cut.

On the other side of the frame, where the outer end of the hand on the carriage passes, is a small trip iron, which strikes on the outer end of the hand, and unlocks its point from the dividing plate; at the same time the large point entering one of the holes in the dividing plate, and the carriage striking the acute angle of the shifting iron, gives it a horizontal motion inwards, which causes the dividing plate and log to shift one number, when the shifting iron strikes the guard screw, *that* prevents its shifting more than one number at a time. The outer end of the hand being now relieved from the trip iron, its point enters a new hole of the dividing plate, by means of the spring, and the carriage again moves forward for another cut.

Thus it operates without any aid except the power that drives it, until it cuts a tier or circle of timber entirely around the log, like the radii of a circle, leaving their thin edges attached to it. These are taken off, and another tier cut in the same manner, provided the log is large enough to admit thereof.

REFERENCES TO PLATE IX.

Fig. 1. is a plan, or top view of the machine, with the log in it, ready for working.
2. A side view of the same.
3. An end view of the same, with a log, as partly cut.
4. Top view of the saw, friction rollers, &c. on an enlarged scale.
5. The saw.
6. The sapper.
7. The hand-frame, spring, and hand.
8. The shifting-iron, in two views.
9. The setting-iron.
10. The trip-iron.
11. The trucks.
12. One of the stands, and friction rollers.
13. The dividing plate.
14. A section of the saw-plate, and two of the teeth, taken above the line, in *a*, *a*, in fig. 5.
AA. The frame, which is made of timber, about eight by fourteen inches, and put together by screws.
BB. The carriage, made of timber, about seven by eight inches, put together by screws.
C. The log, as dogged, and put into the machine.
D. Saw and sappers.
E. Main pulley and shaft.
F. *Feed-pulley* and shifting gear, which is connected to the rack, under the carriage.
G. Tightening pulleys.
HH. Regulating pulleys and shaft.
II. Friction rollers, and one of the stands.
J. Dividing plate.

K. Dividing shaft and dog.
L. Centre-iron and dog.
MM. Iron slides, bolted to the sides of the frame, for the trucks to travel upon.
NN. Reversing lever, and springs.
O. Pin, which attaches the lever to the side of the frame, and is the fulcrum on which it moves.
P. Projection on the underside of the carriage, that actuates the reversing lever.
Q. Hand-frame, spring, and hand.
R. Shifting-iron, and long point.
S. Setting-iron, which is bolted to the underside of the carriage, and strikes the acute angle of the shifting-iron, when the carriage returns to set.
T. Trip-iron, which unlocks the hand from the dividing plate, when the carriage returns to set.
UU. Stirrup screws.

Remarks, &c.

This machine furnishes a new method of manufacturing timber, for various useful purposes. Though the circular saw had previously been in operation in this country, and in Europe, for cutting small timber, it had not, within the knowledge of the writer, been successfully applied to solids of great depth; to effect which, the use of sectional teeth are almost indispensable.

In my first attempts to employ the circular saw, for the purpose of manufacturing clap-boards, I used one nearly full of teeth, for cutting five or six inches in depth into small logs. The operation required a degree of power almost impossible to be obtained with the use of a band; the heat caused the plate to expand, and the saw to warp, or, as it is termed, to get out of truth. To obviate these difficulties, I had recourse to the use of sectional teeth, and the improvement completely succeeded. The power required to perform a given quantity of work by the other method, was, by this, diminished at least three-quarters.

The work formerly performed by saws, with seventy or eighty teeth, was, by the last method, performed by eight teeth; the saw-dust, which before had been reduced to the fineness of meal, was coarser; but the surface of the timber was much smoother than when cut with the full-toothed saw.

The sectional teeth are made in the form of a hawk's bill, and cut the log up from the circumference towards the centre. The saw may be carried by an eight-inch band, and when driven at a proper speed, (which is from ten to twelve hundred times per minute,) will cut nine or ten inches in depth, into the hardest white-oak timber, with the greatest ease. The sappers at the same time cut off from one to two inches of the sap, and straighten the thick edges of the timber.

The facility with which this saw will cut into such hard materials, may be supposed to result from the well-established principle,—that, when two bodies in motion come into contact, their respective action on each other is in direct proportion to their respective velocities. Thus, a circular plate of iron put into a quick rotary motion, will, with great ease, penetrate hard steel, or cut off a file, when applied to its periphery; and the same principle is applicable to a rotary saw for cutting wood. The requisite degree of velocity is obtained by the continuous motion of the circular saw; by which also it has greatly the advantage of one that has but a slow motion, on account of dulling, as the teeth are but little affected; and, being only eight in number, but a few moments' labour is required to sharpen them. If the velocity of the saw was slackened to a speed of but forty or fifty times per minute, it would require at least four such bands to carry it through the log, as that above described.

One machine will cut from eighteen to twenty hundred square feet of pine-timber per day; and two of them may be driven by a common tub-wheel*, seven or eight feet in

* Or horizontal water-wheel.—Editor.

diameter, having six or seven feet head of water, with a cog-wheel and trundle-head, so highly geared as to give a quick motion to the drums, which should be about four feet in diameter. The machine is so constructed as to manufacture timber from four to ten feet in length, and from two to ten inches in width, and of any required thickness.

It has been introduced into most of the New-England States, and has given perfect satisfaction. The superiority of the timber has for three years past, been sufficiently proved in this town, where there have been annually erected from fifteen to twenty wooden buildings, and for covering the walls of which, this kind has been almost universally used. The principal cause of its superiority to mill-sawn timber, is in the manner in which it is manufactured, viz.: in being cut towards the centre of the log, like the radii of a circle. This leaves the timber feather-edged, in the exact shape in which it should be, to sit close on a building; and is the only way of the grain, in which weather-boards of any kind can be manufactured to withstand the influence of the weather, without shrinking, swelling, or warping off the building. The mill-sawn timber, which I believe is now universally used in the middle and southern states, and in the West Indies, for covering the walls of wooden buildings, is partly cut in a wrong direction of the grain, which is the cause of its cracking and warping off, and of the early decay of the buildings, by the admission of moisture. That such is the effect, may be inferred from examining a stick of timber which has been exposed to the weather; the cracks, caused by its shrinking, all tend towards the heart or centre, which proves that the shrinking is directly the other way of the grain. It follows, that timber cut through or across the cracks, would not stand the weather, in a sound state, in any degree to be compared with that which is cut in the same direction with them. I have no hesitation in stating, that one half the quantity of timber manufactured

in this way, will cover, and keep tight and sound, the same number of buildings, for a hundred years, that is now used and consumed in fifty years. Add to this, the reduction of expense in transportation, and of labour in putting it on; and, I think, every one must be convinced, that the timber manufactured in this improved way, is entitled to the preference.

In manufacturing staves and heading, a great saving is made in the timber, particularly as to heading; of which, at least, double the quantity may be obtained by this mode of sawing, to what can be procured in the common method of riving it; nor is the straight-grained, or good rift, indispensable for the saw, as it is for the purpose of being rived. The heading, when sawn, is in the form it should be, before it is rounded and dowelled together, all the dressing required, being merely to smooth off the outsides with a plane. Timber for staves ought to be straight in order to truss, but may be manufactured so exact in size, as to require but little labour to fit them for setting up.

Both articles are much lighter for transportation, being nearly divested of superfluous timber, and may be cut to any thickness required, for either pipes, hogsheads, or flour barrels.

Brunswick, Maine, April 4, 1822.

LVIII.—*On the Manufacture of Starch in France**.

Amidon. — *Starch.* This substance is widely diffused throughout nature, and constitutes the most important nutritive matter among the immediate principles of vegetation; it is found in greater or less quantities in chesnuts, horse-chesnuts, potatoes, grain of all kinds, and in many different roots; it is identified in all plants under certain general characters; but it frequently differs very much with respect to its form, and its greater or lesser solubility in boiling water, &c.

* From the *Dictionnaire Technologique*.

Amidon, or starch, is white, pulverulent, insipid, inodorous, little hygrometric or alterable by the air, cold water, alcohol, or ether. Its brilliant aspect and almost crystalline appearance are easily distinguishable by the naked eye, particularly when the substance is extracted from potatoes; and by the aid of a microscope it is readily discerned, when produced from any other vegetable.

M. M. Vauquelin and Bouillon-Lagrange have observed, that by slightly torrefying the starch with due precaution, we modify its properties, without decomposing it; that it then becomes soluble in water at the ordinary temperature, and acquires a great resemblance to gum, for which it may be substituted in most of its uses in the arts. At a more elevated temperature the starch becomes brown, liquifies, bubbles, and is decomposed, like all other vegetable matters, affording the same volatile products, and leaving a carbonaceous residuum.

We may ascertain the presence of starch by means of *iodine*, with which it forms combinations of different colours: that which contains the least possible quantity of iodine appears white; the others, accordingly as the proportions of iodine are augmented, become successively of a violet colour, then blue; and finally, quite black, when the quantity of iodine is very considerable.

In order to convince ourselves of the presence of starch in any liquid, water must be added to it, which has been kept for some time in ebullition on a little iodine*; it is instantly manifested by the appearance of a blue colour. To obtain from this combination the finest blue colour possible, they treat the starch with an excess of iodine, dissolve the sediment in potash, and precipitate the solution afresh by means of acetic acid.

Starch is also rendered soluble in cold water, by previously triturating it with potash: all the acids decompose this combination, and the starch is precipitated. The sub-nitrate of lead, and the sub-acetate of the same

* Or an alcoholic solution of iodine may be used for this purpose.

metal, when they are made to boil with any liquid containing starch in the state of clear jelly, produce a precipitate composed of 38.89 of protoxide of lead, and 100 of starch. . . . . .

The sulphuric acid may be united with starch, and form a crystallizable combination (Theodore Saussure, *Annales de Chimie*, tom. XI). The same acid diluted with water at the temperature of ebullition, converts the starch into a saccharine matter, analogous to that obtained from grapes. . . . . .

Under many circumstances starch is partially converted into sugar, either spontaneously and in contact with the air, or by an addition of gluten; or, when it is united with this principle, as in many species of corn; and also when it undergoes decomposition during the act of germination; or finally, in the alcoholic, the acid, and sometimes even in the putrid fermentations. Spontaneous fermentation also converts one part of the starch into a gummy matter, analogous to that obtained by torrefaction, and into a substance which M. Saussure has named *amidine*; whose properties are intermediate between the other two states of starch (the gummy and its natural state). If this decomposition take place when not in contact with the air, it forms the carbonic acid, in consequence of the combination of the oxygen of the air in the vessel, with the carbon which separates during this process: water is also formed, which is one of the principles of the starch; and the dry residuum obtained weighs less than the starch employed. When the same spontaneous fermentation takes place in contact with atmospheric air, a little carbonic acid and pure hydrogen gas is formed; but no charcoal is deposited. M. Saussure thinks, that in this case there is an augmentation of weight, owing to the starch having fixed, or appropriated to itself a small quantity of the principles of the water; but, in fact, we think that it resembles the effects which take place under other circumstances; namely, in the saccharification of starch by sulphuric acid.

We have found the following to be the relative quantities produced during these re-actions:

	Starch fermented not in contact with the air.	Starch fermented in contact with the air.
Saccharine matter . . .	49.7	47.4
Gummy matter	9.7	23.0
Amidine	5.2	8.9
Ligneous and amylaceous matter :	9.2	10.3
Ligneous matter mixed with charcoal	0.3	An inappreciable quantity.
Starch not decomposed .	3.8	4.0

Of all these products, the saccharine matter is the only one soluble in alcohol; and cold water perfectly dissolves the gummy matter, without acting upon the amidine. We take advantage of these properties, and those which the starch presents in its transformation into a saccharine matter by the sulphuric acid, to separate these substances. Nitric acid diluted with water dissolves starch in the cold; more concentrated, and with the assistance of heat, it oxidates it, and transforms it into the malic or oxalic acid; and disengages the nitrous acid.

The Preparation of Starch.—We shall now describe the process by means of which this substance is extracted in the large way from several species of grain.

The starch of wheat, rye, barley, &c., being prepared by the same method, we shall treat of these grains without distinction, either as to their being used singly, or mixed in various proportions. They prefer that grain which has been injured by remaining long in damp warehouses, and thereby rendered improper for most other purposes; not only because it is cheaper, but because the starch, being less alterable than most other immediate products from vegetables, is still obtained in great abundance, with more facility, and often even in nearly an equal quantity, as from uninjured grain.

They commence the operation by coarsely grinding the grain. It is effected in the ordinary mills by raising the

upper mill-stone, by which means the space between the two stones is augmented, and the grain passes through, merely bruised. If the grain employed be too wet, it sticks between the stones, from which it is with difficulty disengaged, and more power is required to obtain even this small quantity; but this inconvenience is avoided by a previous desiccation. After this first preparation, they steep the grain, thus bruised, in large tubs half filled with water, to which they add an eighth or a tenth part of the *sour water* remaining from a former operation: by degrees fermentation takes place, and proceeds with a rapidity in proportion as the grain employed contains a greater quantity of gluten, or as the temperature of the atmosphere is more elevated. When fermentation has commenced, the liquor becomes viscous, acquires a degree of acidity, and at length is covered with a thickish crust of mould. In this state they term it *sour water**: this water is drawn off by means of a cock, placed at the height which the deposit occupies in the tub; or by means of a portable syphon, which serves for many tubs: but previously they take off the crust of mould, or *head*, with a skimmer; the greater part of the gluten is decomposed; and the products of this decomposition, with the extractive matter of the grain, are separated by this first decantation: they wash the deposit many times, and afterwards mix it with water, and throw it into a hair or wire-sieve, resting upon two pieces of wood placed across the top of a vat. They have lately applied to this operation (in order to separate the coarsest bran) a revolving sieve, made in the manner of an Archimedian screw. This instrument is a cylinder, the interior of which is traversed by a continued band of diaphragms, disposed around an axis in the form of a screw; and on these the cloth is retained in a cylindrical form. The axis of this sieve is made cylindrical at each extremity, and turns upon two proper bearings; it is placed obliquely, so as to form an

* It is composed, according to M. Vauquelin, of water, acetic acid, acetate of ammonia, phosphate of lime, and gluten.

angle of from 20° to 30° with the horizon: it may either be turned round by means of a winch or handle, in the same manner as the Archimedian screw used in draining morasses; or by a leather strap and a pulley. The construction of this machine is exactly the same as that of the elevating screw; only their functions being different, the movement given to them must be in a contrary direction; so that instead of the screw, as usual, raising portions of liquid from below, at intervals quickly succeeding each other, until they are finally discharged at the top of the screw—in this case, the machine is constantly fed at its highest part, with the mixture formed by the deposit which we have before spoken of. A small stream of water runs upon the exterior of the metallic cloth, and incessantly washes it: the operation is thus carried on in a continued manner; and the bran, or ligneous covering of the grain, escapes at the lower part of the sieve, perfectly free from the starch which it contained. That which has passed either through the revolving sieve of the new machine, or the ordinary sieve of the starch-makers, affords by repose and decantation, a *sour water*, which is employed in the same manner as that we have before described. As, however, the deposit contains, besides starch, a quantity of very fine bran; to effect the separation of these two substances, it is beaten up with water, and left to settle: the starch precipitates first, and occupies the bottom of the vat; the bran falls next, and forms the upper part of the deposit. They remove the surface until they arrive at the starch, which is known by its whiteness and firmness: they rinse the surface of the starch, to free it from those particles of bran which may still adhere to it; they again beat up the white mass, thus rinsed, and pour the whole into a silk sieve, or into a machine similar to the one we have above described; but with this difference, that its exterior covering is formed of a cloth closer in its texture, resembling that of a silken sieve. By one or other of these means they separate an additional quantity of fine bran, and the

starch which passes is whiter and purer: nevertheless it must be again beaten up with water, suffered to repose, the supernatant water decanted, and the surface of the deposit be again rinsed, which is still a little soiled by the finest particles of bran. The starch is now very white: in general, however, its whiteness and purity depend upon the precautions which have been taken in the many washings, and on the fineness of the last sieve through which it has been passed.

Desiccation.—This operation, although very simple, nevertheless requires many precautions; for the whitest starch when taken from the last washings, often becomes of a brownish or greenish colour, which requires it to be again mixed with the common starch which is obtained from the rinsings, or from those grains which are the most injured, and which are classed, according to their whiteness, into various qualities. They put the starch, ready to be dried, into square baskets, (whose angles however are rounded off,) each being furnished with a loose cloth. These baskets are generally of the following dimensions: 50 centimetres long, 34 wide, and 28 high; they fill them as full as possible with starch, and compress it by slight jerks; they leave it awhile to drain and stiffen; it is then carried to the drying-house. This is a large building, whose upper part is divided into many compartments, surrounded with shutters, and the interior furnished near its sides with stages of wooden planks laid horizontally, at the distance of about 40 centimetres apart; there is also a level bed of plaister of Paris formed close to these stages. They deposit the contents of their baskets upon this bed, and remove the cloths which have quitted the baskets with the moulded blocks of starch.

The starch is thus brought to its first degree of desiccation: they carry it afterwards to the stages, and divide each block into sixteen parts, for the purpose of presenting a greater surface to the drying action of the air: these are very frequently turned, as well to accelerate the desiccation,

as to avoid the least mouldiness, or dust, &c. which might soil the starch, and which there is less chance of guarding against, by a longer continuance on the stages: they then carry these pieces to a stove, first taking care to scrape their surfaces slightly; they are then divided into smaller pieces by the hand, always keeping in view the drying of this substance as quickly as possible; they should be turned, from time to time, with a wooden spatula, to change their surfaces. By these precautions, which it is proper to increase or diminish according to the hygrometric state and temperature of the atmosphere, it is certain that the starch will be preserved in its original whiteness.

Knowing the composition of the various grains, of barley, wheat, &c. we can thus establish the theory of what takes place in the preparation of starch. These grains contain much starch, the ligneous matter forming the husks of the grain, a small variable quantity of gluten, albumen, and certain salts; amongst others, the phosphate of lime.

The re-action of the gluten upon the starch occasions the formation of a little saccharine matter; the continued ferment in the mixture causes the *spirituous fermentation*, and produces alcohol and carbonic acid. This last is disengaged in the gaseous form, and from thence are derived the bubbles which arise and burst at the surface of the liquor. The *acid fermentation* immediately follows; the *sour water* necessarily excites this fermentation, from which results a new quantity of vinegar; and soon after, the gluten, by reason of the large quantity of azote which it contains, and its facility of spontaneous alteration, gives birth to the *putrid fermentation*, which developes ammonia; the gluten and the phosphate of lime are, in part, dissolved in the liquor by the acetic acid, and are partly held in suspension: the re-union of these principles forms the *sour waters* of which we have spoken.

It often happens that the *sour waters*, when they are poured upon the bruised grain, in the first part of the ope-

ration, subside, without occasioning any disengagement of carbonic acid gas, any sensible movement, or any other change than making all the liquor thick, gluey, and ropy. This alteration, to which they have given the name of the *viscous fermentation*, although of little importance here, is very remarkable; it is accidentally presented in many other cases, and particularly in the treatment of saccharine matters, where it is almost always injurious, and often occasions considerable loss.

Uses.—Starch is employed in many of the arts, although but in small quantities: painters, confectioners, laundresses, &c. make great use of it; physicians prescribe it as an aliment of a peculiar nature, and as a medicine; but in this case, as also in the manufacture of sugar from starch, they give the preference to the starch or fecula of the potatoe.

Composition.—Starch is formed in weight, according to M. Berzelius, of

Carbon	43,481
Oxygen	49,455
Hydrogen	7,064
	100.

P.

LIX.—*On the Use of the Blow-pipe in Chemical Analysis, and in the Examination of Minerals. By* J. J. Berzelius. *Translated from the French of* M. Fresnel. *By* J. G. Children.

[Continued from p. 83.]

WITH A PLATE.

Agreeably to our promise we now give further extracts from this valuable work.

DESCRIPTION OF THE BLOW-PIPE.

Various constructions of this useful instrument are shewn in a plate, and also described under this head:—such as "the blow-pipe commonly employed in the arts, being a conical brass tube about 13 inches long, 3-8ths of an inch

in diameter at the larger end, and having an opening at the smaller of rather less than 1-16th of an inch. It is bent at a right angle at about an inch from the point." Cronstadt's, which resembles that just described, except in the addition of a hollow ball to collect the condensed vapour. Bergman's, with a semi-circular chamber, instead of the hollow ball of Cronstadt's: and Gahn's, with a tube in place thereof, and which M. Berzelius prefers to all the others. Tennant's, and Wollaston's, are then described, which, in respect to portability, are certainly preferable to any; the latter in particular, which "packs with perfect convenience in one's pocket-book; and if we add to it a slip of platina foil, and a small piece of borax, we are furnished at once with a sufficient laboratory for a great variety of operations —as the candle and charcoal may be found every where. *The length of a blow-pipe, whatever be its form, must depend on the eye of the operator, and be such, that the body operated on may be at that distance from his eye, at which he has the most distinct vision**."

"Blow-pipes are best made of silver, or tinned-iron plate, the beak being made of brass. If the instrument be wholly of brass, in time it acquires the odour and taste of verdigris; an inconvenience not entirely removed, by making the mouth-piece of ivory. The hands too, if not quite dry, contract the same odour during the operation, especially if the blow-pipe has not been used for some time, and was not well cleaned before it was laid by. Tin plate is not liable to this nuisance, and has, besides, the advantage of cheapness†. When that material is em-

* This last remark, however, militates considerably against the utility of these *very portable* blow-pipes, which must be made considerably longer and larger than those shewn in the plate, to answer their intended purpose.—EDITOR.

† The celebrated Dr. Black's blow-pipe was made of tinned-iron plate, with brass beaks, and was a favourite instrument with the chemists of this country. It was of a conical form, widening from the mouth-piece, and was considered to be a great improvement upon those which tapered to the point, in respect of the ease in using it; the beak was placed near its bottom: it is well worthy of adoption in the laboratory. See Plate X. fig. 3.—EDITOR.

ployed, the joinings should be made air-tight by inserting pieces of paper between them. Notwithstanding that silver is the best conductor of heat of all the metals, no inconvenience need be apprehended on that score, even in the longest operations. The small jets adapted to the extremity of the beak are a great improvement; for the extremity is liable soon to become covered with soot, and the hole to be either blocked up, or lose its circular form, and it is necessary to clean it, and clear the opening with a small needle kept at hand for the purpose. This is an indispensable but troublesome operation. I have, therefore, had these jets made of platina, each of a single piece; and when dirty, I heat them red-hot on a piece of charcoal, which cleans them in an instant, and clears the hole without the assistance of any mechanical agent. Silver would not answer the purpose, for however careful we may be not to fuse it in the operation, it would crystallize as it cools, after having been heated to redness, and become as brittle as an unmalleable metal.

"Glass blow-pipes are certainly less costly and less liable to get dirty than those made of metal; but their brittleness, and the fusibility of their beaks are such serious inconveniences, that they should never be used but in cases of necessity‡.

"Attempts have been made at different times to construct blow-pipes of greater facility in their management than the one in common use. De Saussure fixed his to a table, so as to have his hands at liberty, whilst he regulated the blast by his mouth. I know no case in which much advantage is derived from this plan; moreover, the variations in the sort of flame required in experiments with the blow-pipe, depend on such slight changes in the position of the beak,

‡ In this country, blow-pipes are generally made of brass; and, when well lackered, I have never been annoyed with the inconveniences Berzelius complains of. The mouth-piece should be of silver, and the beak of platina;—were it not for the expense, the whole instrument were better made of platina.—C.

that it is impossible to accomplish them with precision by the mere action of the mouth.

"It is generally supposed, that to use the blow-pipe is a difficult operation, that it requires great pulmonary exertion, and may be injurious to the health. Partly for this reason, and partly for want of skill to keep up a continued blast without inconvenience, various contrivances have been hit upon to supersede the blowing with the mouth. Such are those of Ehrmann, Köhler, Meusnier, Achard, Marcet, Brooke, and Newman, by means of which the highest degrees of heat are produced, on a small scale, by an artificial blast of atmospheric air, or oxygen gas: but as the use of these instruments has no connection with our subject, I shall abstain from further notice of them.

"Hassenfratz supplied his blow-pipe with air by means of a pair of bellows worked by the feet, after the manner of enamellers; and Näsen employed for the same purpose, a bladder filled with atmospheric air, which he compressed between his knees, with a force proportionate to the blast required. When empty, it was filled again by the mouth, through a separate tube, furnished with a stop-cock, and fitted to the bladder.

"By these pretended improvements, motions more or less troublesome have been substituted for a slight exertion of the muscles of the cheeks; and their inventors have demonstrated, by their very contrivances, that they did not know how to use the blow-pipe; they might as well have proposed to play on a wind-instrument with a bladder. Our conclusion must be, that all apparatus of this kind is perfectly useless."

"OF THE BLAST AND FLAME.

"The organs of respiration are not called into increased action in using the blow-pipe; they could not keep up a continued blast, and such an effort would in time be injurious. It is the cheeks which perform the office of a pair of bellows: the mouth is filled with air, and by the contrac-

tion of the muscles of the cheeks it passes into the blow-pipe. This operation, simple as it seems, is difficult at first, from the habit of exerting all the muscles concerned in respiration when we blow. It is a difficulty like that which a man experiences, when he endeavours at the same time to turn his right arm and right leg in opposite directions. A little wearisome practice, therefore, is necessary to get over the custom of bringing the muscles of the chest into action with the muscles of the cheeks. The first thing to be attended to, is to keep the mouth full of air, during a pretty long alternation of inspirations and expirations: next, we must consider that there is a small opening between the lips, by which the air escapes; so that the cheeks would collapse by degrees, if the breath from the lungs were cut off from entering into the mouth. Now, to fill the vacuum which is thus formed, at the moment of expiration we admit a portion of air into the cavity of the mouth, sufficient to renew the distension of the cheeks. Thus the air in the mouth is always in an equal state of compression, and escapes with uniform velocity through the little orifice. Such is the mechanism of the operation in which the art of using the blow-pipe consists. We may add, that the current of air which escapes by the beak of the instrument, is commonly so minute, that it is not necessary to fill the cavity of the mouth at each expiration*. This operation, though somewhat difficult at first, soon becomes easy by practice, and at length is performed without occasioning the least distress to respiration. The only inconvenience that remains, when once arrived at that point, is a lassitude in the muscles of the cheeks, arising, independently of want of practice, from the beginner's generally pressing the mouth-piece of the blow-pipe more strongly than is necessary between the lips, and not sufficiently economizing the blast.

"Having accomplished the first object—of keeping up a steady blast,—the next is, to produce a good heat; which

* In fewer words, the operator must breathe through his nostrils, and blow with his mouth, by the mere compression of the cheeks.—C.

requires some knowledge of flame, and of its different parts. If we attentively consider the flame of a candle, we may remark several unequal divisions in it, of which four may be distinguished. Plate X., fig. 1, represents the flame of a candle in its usual form. We see at its base a small part, *a, c,* of a dark-blue colour, which becomes thinner as it gets farther from the wick, and disappears entirely where the external surface of the flame ascends perpendicularly. In the middle of the flame is a dark place, *a, d,* seen through its brilliant covering. This space incloses the gases which issue from the wick, which, not being yet in contact with the air, cannot undergo combustion. Round this space is the brilliant part of the flame, or the flame properly so called: and lastly, beyond this, we may perceive by attentive inspection the outer covering of all, *c, e,* slightly luminous, and whose greatest thickness corresponds with the summit of the brilliant flame. It is in this outer part that the combustion of the gases is completed, and the heat the most intense. If we introduce a fine platina or iron wire into the flame, we see that the point of the wire where the ignition is most vivid, is situated on the confines of the brilliant flame, and in the external covering. If the wire be very fine, its real diameter appears singularly magnified; and this apparent enlargement (which is a phenomenon of radiation of the same kind as that presented by the fixed stars, when we ascribe appreciable diameters to them,) increases as we approach the upper boundary of the blue flame; so that this zone of transition, where the air, as yet retaining its full dose of oxygen, begins to meet the flame, is the place of the maximum of heat. This being granted, if we direct a current of air by the blow-pipe into the middle of the flame, (Plate X. fig. 2,) a long narrow blue flame, *a, c,* appears before the opening in the beak, which is the same as *a, c,* in fig. 1, but its relative position is changed; instead of surrounding the flame, it is now concentrated within it, where it forms a small cylinder. Toward the anterior extremity of this blue flame is the place

of greatest heat, just as in the flame not acted on by the blow-pipe. But whilst in the latter this place had the form of a zone, or circumference of a circle, it is now reduced to a point incomparably hotter, and capable of fusing or volatilizing substances on which the flame in its common state has no sensible action. This enormous increase of temperature arises from the blow-pipe throwing a condensed mass of air,—which before only touched the surface of the flame, and spread itself freely about every part of it,—on a small space situated in the middle. The change effected is somewhat the same as if the flame had been turned inside out. On the other hand, the remaining portion of the bright flame which here surrounds the blue, prevents the loss of the heat produced.

"Long practice is necessary to distinguish with certainty the maximum of heat; seeing that different bodies have different modes of ignition, and that we are easily deceived by the light which they emit. To attain this maximum, we must neither blow too strongly nor too gently. In the first case, the heat is carried off as soon as produced, by the impetuosity of the current of air*; and besides a part of the air escapes without assisting the combustion. In the second, sufficient air is not supplied in a given time. A very high temperature is necessary, whether we wish to try the fusibility of a body, or whether we have to reduce certain metallic oxides, which part with their oxygen with difficulty, as the oxides of iron and tin. But our pyrognostic operations are not confined to obtaining the highest possible temperature; other phenomena must be produced, which require a less intense heat;—these are oxidation and re-

* Perhaps the explanation may be more satisfactory in the words of Sir Humphry Davy. "A large quantity of cold air thrown upon a small flame, lowers its heat beyond the explosive point; and in extinguishing a flame by blowing upon it, the effect is probably principally produced by the same cause."—(Safety-Lamp, p. 46.)

The injurious effect of blowing too strongly, may, I conceive, rather be owing to the extinction of a portion of the flame, in the manner above mentioned; than to the heat being carried off as soon as produced, by the impetuosity of the current.—C.

duction, which are both easily effected, although diametrically the reverse of one another.

"*Oxidation** ensues when we heat the subject under trial before the extreme point of the flame, where all the combustible particles are soon saturated with oxygen: the farther we recede from the flame, the better the oxidation is effected (provided we can keep up sufficient heat); too great a heat often produces a contrary effect, especially when the assay is supported by charcoal. Oxidation goes on most actively at an incipient red-heat. The opening in the beak of the blow-pipe must be larger for this kind of operation than in other cases.

"For *reduction*, a fine beak must be employed, and it must not be inserted too far into the flame of the lamp. By this means we obtain a more brilliant flame, the result of an imperfect combustion, whose particles, as yet unconsumed, carry off the oxygen from the subject of experiment, which may be considered as being heated in a species of inflammable gas. If in this operation the assay become covered with soot, it is a proof that the flame is too smoky, which considerably diminishes the effect of the blast. Formerly, the blue flame was considered as the proper one for the reduction of oxides, but this idea is erroneous; it is in reality the brilliant part of the flame which produces deoxidation: it must be directed on the assay so as to surround it equally on all sides, and defend it from the contact of the air.

"I repeat, it is the combustible atmosphere in which the assay is immersed, that most powerfully promotes its reduction; for that produced by the charcoal, at its point of contact with the oxide, takes place as well in the exterior as in the interior flame.

"The most important point in pyrognostic assays, is the power easily acquired of producing at will either oxidation

* Our readers will be aware that we have already given this and the following paragraph, and the latter part of the next but one, in our former Article on this subject, (pp. 74 & 75); but we have deemed it necessary, in order to preserve their relation with the context, to republish them.—EDITOR.

or reduction. Oxidation is so easy, that any one need only be told how it is to be done, to be able to do it: but reduction requires more practice, and a certain knowledge of the different modes of conflagration. A very advantageous mode of practice, in order to acquire the art of making a good reducing flame, is to fuse a small grain of tin, and raise it to a reddish white-heat on a piece of charcoal, so that its surface may always retain its metallic brilliancy. Tin has so great a tendency to oxidation, that the moment the flame begins to become an oxidating one, it is converted into an oxide of tin, which covers the metal with an infusible crust. We must begin by operating on a very small grain, and gradually proceed to larger and larger. The greater the quantity of tin that he can thus keep in the metallic state, at a high temperature, the more expert is the operator in his art†.

"OF THE SUPPORTS.

"*Charcoal.*—The substance to be examined by the blow-pipe must necessarily rest on a solid body, or be fixed in some manner in a steady position. The best support is charcoal. The wood of a sound well-grown pine-tree, or light woods in general are preferable. The charcoal of the fir-tree is liable to crackle and scintillate, and to scatter the assay. The charcoal of hard compact woods gives so much ash, and that ash is sometimes so ferruginous, that it should never be employed but for want of better: for this reason, beech and oak are not fitted for the purpose. I have never yet had an opportunity of trying box-wood charcoal. Gahn always conceived that it would be the best of all for blow-pipe experiments; but he seldom had the choice of any other than our pine-wood coal. Of the various kinds which I have tried in countries where those above-mentioned are not found, it appeared to me that the charcoal of white-willow, or of the willow species, was the best; but I still

† If a red-hot grain of metallic tin be thrown on a paper tray, it will divide into several smaller grains, which skip about the paper, and burn with a very vivid light.—B.

prefer that of the mature pine, cleft in the direction of the grain, which may be divided by the saw into long parallelopipedons, and be cleaned by simply blowing off the dust." The method of fixing the assay "on one of the ends, perpendicular to the layers of the wood," has already been given in p. 76 of this work, and need not here be repeated.

"It is almost needless to observe, that the charcoal we use must be well burnt: that which splits, smokes, or burns with flame, is unfit for the purpose*."

"*Platina.*—In those cases where the reducing effect of charcoal would be injurious, a support of platina is employed, sometimes in the form of a spoon, sometimes in that of thin foil or wire.

"*Platina Spoons.*—Gold and silver spoons were formerly used when a mineral was to be fused with soda; but being liable to be melted, platina spoons have been substituted for them. These, however, are become quite superfluous in experiments with the blow-pipe, since it has been found that mineral substances may be heated with soda on charcoal, better than on any other kind of support. Besides, the size of the spoon† prevents our obtaining the very high temperatures which are often necessary.

"*Platina Foil.*—Wollaston substituted very thin platina foil, cut into slips about two inches long and half an inch wide, in the place of spoons. This foil, from its thinness, may be intensely heated; and when we wish to heat and oxidate at

* The best charcoal that I know for the use of the blow-pipe, is that which is made from *alder*, and is employed by English manufacturers in making the coarser kinds of gun-powder. It is light, but sufficiently compact, extremely even in its texture, and, when well burnt, neither smokes, splits, nor scintillates. Straight pieces, free from knots, should be selected.—C.

† By making the spoon of very thin foil, this objection might perhaps be done away; but still its form is objectionable and disadvantageous.—C.

An improvement on these thin platina spoons has been lately made by Mr. Tuther, Philosophical Instrument-maker, Holborn. It consists in forming a flat rim around the margin of the spoon, which very much assists in strengthening it and preserving its form. In Plate X. fig. 4 & 5, we have given a front and edge view of one of these improved spoons, with an ivory handle.—EDITOR.

the same time, the flame is to be directed against the lower surface. Platina is so bad a conductor of heat, that the slip of foil may be held in the fingers by one end, whilst it is red-hot at the other. Substances in the metallic state, or those oxides which are reducible *per se* before the blow-pipe, must not be supported on platina foil; for the platina will alloy with them, and fuse into holes.

"*Platina Wire.*—Gahn, who knew the inutility of spoons, but was not acquainted with the use of platina foil, employed a platina wire two inches and a half long, and bent at one end into a hook (Plate X. fig. 6)‡. I may here remark, that platina is not at all acted on by the salt of phosphorus. I have endeavoured in vain to phosphorise it, even though I heated the point of a platina wire in a mixture of boracic acid and salt of phosphorus, supported on charcoal before the blow-pipe. When the reduction has been carried as far as is judged necessary, and we wish by suddenly cooling the globule to prevent its oxidating afresh, we may throw it whilst in fusion, by a gentle tap against the wire with the finger, on some cold body, as a porcelain capsule, or an anvil, where it will cool immediately. We should be provided with several of these platina wires, to avoid the necessity of forcibly detaching the glass, or of being obliged to wait whilst it slowly dissolves in water.

"In travelling, good charcoal is extremely hard to be met with, and a large quantity of it is troublesome to carry about. The platina wire is then absolutely indispensable, and enables us to save our charcoal for experiments of reduction, or for roasting metallic sulphurets, or arsenical alloys.

"*Disthene*, or *Cyanite*, was employed as a support by Saussure the elder; but it is in no respect preferable to platina foil, and has the disadvantage of being acted on by the fluxes.

"*Plates of Mica* may be used in roasting ores, when the

‡ The method of using it having been already given in p. 75, need not here be repeated.—EDITOR.

deoxidating effect of charcoal on the parts of the assay in contact with it, might be injurious."

Glass Tubes.—This little apparatus is seen at Plate X. fig. 2*.

"*Matrass.*—For ascertaining the presence of water, or any other volatile incombustible contained in a mineral; or if the mineral decrepitate violently, it is best heated in a matrass or flask, whose body is sufficiently large to allow the air to circulate, and the volatile substances to rise. But if we have combustible substances, as sulphur, arsenic, &c. to separate from the assay by sublimation, the body of the flask must be small, since the renewal of the air in a matrass of the former kind might occasion the combustion of the disengaged substances†. Engeström heated decrepitating substances in a hole made in a piece of charcoal, and covered with another piece, leaving a small opening to introduce the flame. Bergman used a glass tube, or a spoon with a cover. Wollaston wraps the substance in platina foil.

"As the matrass is seldom so much heated as to be injured, it may be used repeatedly; but the glass tubes, especially the open ones, cannot be heated a second time, without danger of their breaking at the place where the assay rested, and they were exposed to a high temperature; but this portion may be cut off with a file, the interior cleaned, and the end closed again if necessary; and then they may serve for several experiments. It is well, however, to have a good supply of each sort, as they are continually in request.

"ADDITIONAL INSTRUMENTS.

"*Forceps* are used to hold a small lamina of a substance, when we wish to try its fusibility. Their extremities, at least, should be made of platina. Plate X. fig. 7 & 8, represent the form of a pair, on the best construction, seen in two

* The manner of using it has already been described, p. 76.—EDITOR.

† A glass tube of small diameter, and closed at one end by the lamp, is best adapted to this operation.—C.

directions; *a b*, *a b*, are two thin plates of steel, each having a piece of platina riveted on its extremity, *b*. These plates are fastened in the middle to the same iron plate, *e*, *e*, so as to form a double pair of forceps, steel at one end and platina at the other. An interval is left between the plates at the steel end, but the platina extremities are made to shut close together, by the spring of the steel to which they are riveted ‡. To open them, we press the fore-finger and thumb against the two buttons, *d*, *d*, one of which is fixed in one plate, and passes through the other §. The platina pieces must be strong enough at *b*, to resist the pressure of the steel spring, diminishing in breadth and thickness from *b*, to *c*, that they may not carry off the heat too much from the assay. The steel ends must be hardened at *a*, that they may not be *battered* when used to detach a particle for fusion from the mineral to be examined. These forceps were made in France, and answer their purpose perfectly.

"Those used for the same purpose in England, have a different and less convenient form ‖."

[*To be continued.*]

LX.—*On a Blow-pipe with Two Beaks, invented by the late Mr.* SAMUEL VARLEY. *By the* EDITOR.

IT is stated by M. Berzelius, in the preceding Article, that, for the purpose of *oxidation*, the opening in the beak of the blow-pipe must be larger than in other cases; and that for *reduction*, a fine beak must be employed.

‡ Fig. 9. These extremities of a pair of platina forceps are excavated similar to an ear-pick, *a*; and, when shut, will contain any small gem or substance liable to decrepitate during the application of heat. They will be found extremely useful in examining bodies which are liable to dispersion when heat is applied.

For fig. 9, and the preceding description of it, I am obliged to my friend Mr. Pepys, by whom this very serviceable little instrument was invented. Decrepitation is a momentary phenomenon; it ceases when the assay has been once heated red; after that, it may be treated without any envelope.—C.

§ In the manner of the forceps commonly used with microscopes.—EDITOR.

‖ This is a sufficient reason for our not giving any descriptions or figures of them here.—EDITOR.

Now, amongst all the various blow-pipes described in Mr. Children's recently published translation of M. Berzelius's valuable work, there is not one which is possessed of these necessary properties; and consequently, the operator is reduced to the necessity of continually changing the beaks of his blow-pipe, or the blow-pipe itself, during the progress of experimenting.

We are happy in having it in our power to supply this great deficiency, by giving engravings and a description of one with two beaks, invented many years since by the late scientific Mr. Samuel Varley, and which he employed with great advantage during a long course of chemical, mineralogical, and mechanical pursuits; as it not only afforded him the means of instantly changing the beak, by merely varying the position of the blow-pipe, but also enabled him to perform operations therewith, which the blow-pipe was hardly thought capable of executing; insomuch that he has been able to make silver solder with it, and even solder the bottom of a silver tankard with such solder, keeping it red hot all round, by the employment of this blow-pipe.

Another important advantage attending the use of this blow-pipe is, the great ease afforded to the operator in using it, by enabling him to breathe oftener, and thus afford the lungs liberty to play freely.

Plate X, figs. 12, 13 and 14, represent Mr. Varley's blow-pipe, of the full size of one in our possession, made by Mr. Tuther. The body of it is formed of thin brass tubes soldered together; and the part fig. 13, fits upon the piece of small tube inside the end of fig. 12, to lengthen it when used. The mouth-piece is of silver, and is formed of an oval shape, as shewn in fig. 14. Into each end of the cross-tube of the instrument, a brass block with a screwed hole in it, is soldered, one of which is shewn in section at *a*. Into these holes two beaks, *b*, *b*, are screwed, having apertures of different diameters; and also tubes, which project into the head, and prevent the escape of the condensed vapour at the beaks.

For the laboratory or the workshop, it is by no means necessary to make the stem of this blow-pipe to part asunder, and it would be well to make it longer. Neither is it necessary for both beaks to have screws upon them; one may be fixed, and the other made to unscrew, in order to change it for others with different-sized apertures: or both may be fixed, and have holes of a larger size in them; and their outsides being made conical, platina cones with smaller holes in them, may be fitted to them, as recommended by M. Berzelius.

This blow-pipe also admits of being readily made of tinned iron, with brass beaks; so that no possible objection can be made to it in point of expense:—and when it is considered how greatly preferable it is to the common narrow tapering blow-pipes universally employed by watch-makers, jewellers, &c. in point of ease in using it, it surely ought to supersede them, and be generally adopted.

Mr. Varley found that fresh or unsalted lard was the best material to supply the lamp with*; and he preferred employing for his lamp an earthernware butter-boat: the thick coil of cotton-wick yarn being contained in the body of the vessel, whilst the wick itself lay in the mouth of it, and projected over the end of it, in a very convenient situation for use†.

LXI.—*On the Cultivation of the Filbert; describing the Method of Pruning, as practised in the Grounds near Maidstone, in Kent. By the Rev.* WILLIAM WILLIAMSON, A. M. *of Westbore. In a Letter to the Secretary*‡.

SIR,

THE county of Kent, and more particularly the district round Maidstone, and extending to the borders of Sussex,

* Mr. Lawrence Finn, the celebrated glass-worker in miniature in the Strand, found cocoa-nut oil to be the best substance to feed his lamp with.—EDITOR.

† Mr. Barbon, an excellent maker of barometers, thermometers, &c., used an oval earthenware preserving-pot for this purpose, the wick lying at one end of it.—EDITOR.

‡ From the London Horticultural Society's Transactions.

having been long celebrated for the production of large crops of filberts, and of a much larger size than are commonly grown, a description of the method of cultivation and pruning cannot be unacceptable to the members of the Horticultural Society, more especially as I have reason to believe it is but little, if at all, known in other parts of England.

In order to make myself more clearly understood, I shall treat the subject under the following divisions: *Soil, Raising the Plants, Manure,* and *Pruning;* which last forms the great distinction between the cultivation in Kent, and in other counties.

Soil.—The first consideration in making a plantation is to select a proper soil; for if that be not congenial to the constitution of the plants, we cannot expect any great success. The soil in which the most experienced cultivators suppose the filbert to flourish best, is a *hazle-loam* of some depth, with *a dry sub-soil.* If the sub-soil be too retentive of moisture, the trees are apt to run too much to wood, without throwing out those short twigs upon which the fruit is generally produced. That part of Kent, where the filbert is chiefly cultivated, is a loam upon a dry sandy rock. As a general rule, that soil which is proper for the growth of hops, is thought to be also congenial to the filbert.

Raising the Plants.—There are four methods of raising the plants;—by suckers, layers, grafting, and sowing the nuts. Each is practised, according to the peculiar object of the cultivator. The method adopted in the district above mentioned, is by suckers; they come sooner into bearing, and make stronger plants than either layers or grafts. They are taken from the parent plant generally in the autumn, and planted in nursery beds, (being first shortened to ten or twelve inches,) where they remain three or four years. They are slightly pruned every year, in order to form strong lateral shoots, the number of which varies from four to six. The most free growing plants are

obtained by sowing the nuts; but they are so long in coming to a productive state, and are so much inclined to degenerate into inferior varieties, that this method is never resorted to in making a permanent plantation. The plants raised by laying and grafting are of more humble growth, and therefore better adapted for small gardens, where the economy of space is an object of importance.

Manure.—The filbert requires a considerable quantity of manure: the grounds in Kent are dressed every year, or at least once in two years. Every kind of manure is beneficial; but old woollen rags are found to produce the greatest effect. If Kent had not been a hop country, these would scarcely have been thought of; but as the same soil is congenial both to the filbert and the hop, it would soon occur to the intelligent cultivator, that, probably, woollen rags might be as beneficial to the filbert as they are known to be to the hop.

Pruning.—The method of pruning the filbert being so different from that of every other tree, as far as I know, and being not generally practised beyond the county of Kent, a particular explanation of it will be necessary.

Before any one can possibly prune a tree with propriety, it is necessary that he perfectly understand the mode of its fructification. The fruit of the vine is produced only upon shoots of the preceding year; cherries are grown chiefly upon short spurs emitted from the sides of the larger branches; if therefore the last year's shoots of the vine, or the spurs of the cherry-tree, are destroyed, there can be no fruit. Now in some respects, the filbert is similar in its fructification to both these trees; the bearing branches being *always* those of the preceding year, similar to the vine; and these branches, if the tree be properly pruned, might with great propriety be called spurs, allowing for the difference between the filbert and the cherry: these short twigs or spurs are not more than a few inches long, every bud of which, in a good year, produces fruit. The great object of the following method of pruning, is to cause

the trees to throw out these spurs in great abundance; and when they are got to a proper bearing state, more than sufficient will be produced.

But though it is the usual practice to plant the suckers in nursery-beds, I would advise every one to plant them where they are to remain, whether they are intended for a garden or a larger plantation: and after being suffered to grow without restraint for three or four years, to cut them down within a few inches of the ground. From the remaining part, if the trees are well rooted in the soil, five or six strong shoots will be produced. Whichever method is practised, the subsequent treatment of the trees will be exactly the same.

In the second year after cutting down, these shoots are shortened; generally one-third is taken off. If very weak, I would advise that the trees be quite cut down a second time, as in the previous spring: but it would be much better not to cut them down until the trees give evident tokens of their being able to produce shoots of sufficient strength. When they are thus shortened, that they may appear regular, let a small hoop be placed within the branches, to which the shoots are to be fastened at equal distances: by this practice, two considerable advantages will be gained; the trees will grow more regular, and the middle will be kept hollow, so as to admit the influence of the sun and air: but this, in a large plantation, would be almost impossible, nor indeed is it necessary; though in private gardens, where regularity and neatness are almost essential, it ought to be practised.

In the third year, a shoot will spring from each bud; these must be suffered to grow till the following autumn, or fourth year, when they are to be cut off nearly close to the original stem, and the leading shoot of the last year shortened two-thirds.

In the fifth year, small shoots will arise from the base of the side branches which were cut off the preceding year; these are produced from small buds, and would not have

been omitted, had not the branch on which they are situated been shortened, the whole nourishment being carried to the upper part of the branch. It is from these shoots that fruit is to be expected. These productive shoots will in a few years become very numerous; and many of them must be taken off, particularly the strongest, in order to encourage the production of the smaller ones; for those of the former year become so exhausted, that they generally decay: but whether decayed or not, they are always cut out by the pruner, and a fresh supply must therefore be provided, to produce fruit in the succeeding year.

The leading shoot is every year to be shortened two-thirds, or more should the tree be weak, and the whole height of the branches must not be suffered to exceed six feet. Every shoot that is thus left to produce fruit, should also be tipped, which prevents the tree being exhausted in making wood at the end of the branch.

The filbert is a monoecious plant, and consequently produces the male and female blossoms separately on the same tree: the slender scarlet filaments which are seen issuing from the ends of the buds early in the spring, are the female or productive blossoms; the barren or male blossoms are formed on long cylindrical catkins, which fall off as soon as they have performed their office: in pruning, care must be taken to leave a due supply of these to fructify the female blossoms, or our previous trouble will be entirely useless: this may be done without difficulty, for they are perfectly visible at the time of pruning.

The method of pruning above detailed, might in a few words be called, a system of spurring, by which bearing-shoots are produced, which otherwise would have had no existence.

It frequently happens that a strong shoot springs from the root; and should any of the first year's or leading branches be decayed, or become unproductive of bearing-wood, it will be advisable to cut that entirely away, and suffer the new shoot to supply its place, which, afterwards,

is to be treated in the same manner as is recommended for the others.

Old trees are easily induced to bear in this manner: by selecting a sufficient number of the main branches, and then cutting the side shoots off, nearly close; excepting any should be so situated, as not to interfere with the others, and there should be no main branch directed to that particular part. It will, however, be two or three years before the full effect will be produced.

But though this method of cultivation has long been celebrated, yet it does not appear to me so particularly successful, as to deserve the encomiums which have been bestowed upon it; for though thirty hundred weight per acre have been grown in particular grounds, and in particular years; yet twenty hundred weight is considered a large crop, and rather more than half that quantity may be called a more usual one; and even then, the crop totally fails three years out of five; so that the annual average quantity cannot be reckoned at more than five hundred weight per acre.

When I reflected upon the reason of the failure happening so often as three years out of five, it occurred to me, that possibly it might arise from the excessive productiveness of the other two, the whole nourishment of the trees being expended in the production of the fruit; and that, consequently, they might be unable properly to mature the blossom for the following year. We know that peach and nectarine trees may be so pruned, as to force them to bear a superabundant quantity of fruit in some one year: but we find that a regular crop in succession is thereby prevented, and that too for several years. In order to insure fruit every year, I have usually left a large proportion of those shoots, which, from their strength, I suspected would not be so productive of blossom buds as the shorter ones, leaving them more in a state of nature than is commonly done; not pruning them so closely, as to weaken the trees by excessive bearing,

not leaving them so entirely to their natural growth, as to cause their annual productiveness to be destroyed by a superfluity of wood. These shoots, in the spring of the year, I have usually shortened to a blossom bud, for the reason before given.

The great art of pruning is to produce the greatest quantity of fruit, without injury to the crop of the succeeding year; which, in my opinion, is not done by the Kentish method. But by observing the rule which I have laid down, though the trees do not *perhaps* bear so great a weight in any one year, as by the method before detailed; yet the crops in the whole certainly are not less: with this great advantage both to the public and private grower, that a moderate but regular crop is insured in every successive year. I think that by this plan the average weight in the whole will be greater. The year 1819 was a very productive one, and I grew two hundred weight of filberts (weighed when gathered) upon fifty-seven trees, the greater part of which were not above six years old, (reckoning from the time of their being cut down,) and growing upon three hundred and sixty square yards of ground, which is after the rate of twenty-seven hundred weight per acre; and upon part of the ground ten more trees are now planted, which, if they had come to a bearing state, would have increased the quantity to more than is considered as an extraordinary crop, besides having grown upon the older trees, a moderate but regular quantity for several years preceding. I am the more confirmed in my opinion that the failure is caused by excessive bearing, by observing, that there is very little blossom on my trees this spring, which has not been the case in former years.

In order to strengthen the tree as much as possible, care should be taken to eradicate the suckers from the root, which is effected by exposing the roots to a moderate distance from the stem, to the frosts of winter. The excavation in the spring is filled with manure.

As filberts are several years in coming to perfection, it is

usual to plant hops, standard apples, and cherries among them; and when they come to a bearing state, the hops are destroyed, and the fruit-trees suffered to remain. The ground is then planted with gooseberries, currants, &c. and an under crop of vegetables is likewise frequently obtained. If this were not practised, the crop of filberts alone, except in particular years, would not defray the expense. The distance at which filberts are planted, must depend upon their being mixed with other fruit.

I have been the more minute in my description, both that I might be clearly understood, and also that the directions might be generally useful; and I trust it will not be the less acceptable on that account; for though the minutiæ can only be practised in private gardens, yet the principle can be extended to any plantation, however large.

I remain,

Your obedient humble servant,

WILLIAM WILLIAMSON.

LXII.—*On an improved Mode of forming and sharpening the Points of Etching-needles and Dry-points. By Mr.* EDMUND TURRELL, *Engraver. In a Letter to the* EDITOR.

WITH A PLATE.

DEAR SIR,

IT has always been found a very difficult task to give to etching-needles that beautiful conical point, necessary to produce an equal tint of lines upon a copper-plate, by the aid of the ruling-machine. This figure or shape is found absolutely necessary, on account of the liability there is of the point or needle shifting its position, during the time that a large surface of tint is ruled. But should that be the case, when the point is perfectly conical and central no inequality will be produced in the lines ruled, because the shape of the point, when perfect, will produce equal lines, provided however that an equal pressure be given; and also, that the axis of the cone, and that of the cylindrical

handle of the point, make an equal angle with the copper-plate on which the lines are drawn. Now, if a point is so formed, that, instead of being a perfect cone, small angles and edges are made upon it,—it will be evident, that if lines are drawn upon a copper-plate, and the point be turned ever so little at the completion of each line, a variety of thicknesses will be produced, giving a very unequal appearance to a tint of lines so ruled; and the natural consequence will be, that when the nitrous acid is laid upon the plate, those lines that are broadest, will be more corroded, or acted upon, than those which are narrower; and by that means, the inequality or unevenness between them will be greatly increased—an evil which completely destroys the beauty of certain subjects. Most engravers work or sharpen their etching-points, in a small groove made in a piece of Turkey oil-stone, turning them upon the line which forms their axis, at the same time that they are carried forwards and drawn backwards in the groove of the oil-stone: the formation of a conical point in this way, is attended with much uncertainty, and indeed is only effected by chance at last; for no person can say, when the point leaves the stone, that it will be fit for its intended purpose; nor can it be known, until it has been tried on all sides upon a plate. The unevenness produced in the tints before mentioned, is not the only inconvenience experienced in using a point imperfectly formed. For, as much of the delicate work in landscapes and other subjects is done without the use of nitrous acid, in such case the lines are cut deep enough by the pressure that is given upon the point only. The work thus produced, is technically called *dry-point*, in contradistinction to that which is corroded by the acid. Now, if the dry-point is not a perfect cone, it will be found exceedingly disobedient to the action of the hand of the artist; for a perfectly formed conical point may be drawn almost in any direction with equal facility and ease; whereas, where a point is imperfectly formed, by having angles upon its sides, it will be found to glide or cut in the direction of the

edges that may present themselves; and hence the use of such a point is attended with very great inconvenience and uncertainty, especially in the particular case just stated. I very frequently wished that some mechanical contrivance could be devised, that would render the operation more certain; and, after much consideration, I have at length effected the purpose, at a small expense, and very much to my satisfaction.

The first requisite in such a contrivance was, that of holding the needle to be sharpened, as near to the point as possible; whilst a quick rotary motion was given to it round its axis, by some simple means, always ready, and at the same time portable.

Secondly, that the same contrivance should be capable of holding points of various thicknesses, and in various-sized handles; for, as the etching-points are generally preferred by most engravers, when immoveably fixed in their handles; it followed, as a matter of course, that whatever method was adopted, the inseparable union of the handle and point was not to be disturbed. All these requisites have been provided for in the following manner; viz.:

In Plate XI. fig. 1, *a*, is a front view of a soft bell-metal, or gun-metal, hollow mandrel, holding the etching-point or needle, *b*, fixed in its handle, *c*; the end of the point is held firmly, very near to its extremity at *d*, by the cleft screw-chuck, *e*, assisted by the collar, *f*. *g*, Represents a part of the mandrel formed into a whorl or pulley, for the purpose of receiving motion from a drill-bow, when the mandrel is placed in a proper support or frame, with collars; and which may be clamped to a board or table by a screw. *h*, *h*, Represent the two cylindrical necks or pivots that are to be placed in the collars, and upon which the mandrel, *a*, turns, when the bow is applied to the pulley, *g*.

Fig. 2, shews a similar view of the same parts, placed in the collars of the frame, *l*; and which, as aforesaid, may be fixed to any convenient board or table. The upper part of

the collar frame, *i*, *i*, is formed into a half-ring, or hole, with two ears, which receive into each a screw, *k*, *k*; these serve to confine the mandrel in its place, and at the same time serve also to adjust it, in case it should wear and get loose in the collars. The same letters of reference are used in this figure, as upon the similar parts before named. *l*, Is the collar-frame and clamp, which may be fixed firmly to a board or table by the screw, (shewn in this figure, in dotted lines, at *m*).

Fig. 3, represents a side-view of the collar-frame, *l*, and clamping-screw, *m*: the construction of the upper part of the collar-frame will be better seen in this figure than in the last; as both ears and screws, *k*, *k*, appear in this view. The dotted line, *g*, shews the position of the pulley, when the mandrel is in its place.

Fig. 4, shews a vertical section of the hollow chuck, *e*; the internal part from *d* to *e*, is formed slightly conical, the widest portion being that near *e*; the external part from *e* to *n*, is likewise formed conical, but more obtuse than the internal portion. The conical parts thus formed, are slit down crosswise, parallel to the axis, until they unite with the two holes *o*, *p*, drilled at right angles to each other. The part *q*, is made hollow, and is large enough to receive a common-sized handle of an etching-point or needle; the outside of the same part has a screw formed upon it, at *s*, which fits into a similar screw, in the end of the mandrel.

Fig. 5, shews a vertical section of the collar, *f*, which may be screwed upon the part *n*, of fig. 4; and the small collar at *r*, being forced upon the outer cone of the chuck, at *e*, by screwing it, causes it to close and press upon the etching-point, and holds it firmly in that position while the point is sharpening.

Fig. 6, represents a vertical section of the mandrel, chuck, and collar, combined; as they appear whilst holding an etching-point to be sharpened; but, in order to render the parts more distinct, the etching-point is not shewn. The combination of the parts in fig. 6, is precisely the same

as shewn in fig. 2, except the addition of the etching-point, and the collar-frame, in which the mandrel turns.

The method of using this instrument is as follows: viz. The collar-frame and mandrel being properly combined, are to be screwed to the edge of a board or table, by the clamp screw, *m*; and the chuck, *e*, with its collar, *f*, are to be taken from the mandrel; and the collar being taken off, the etching-point or needle is to be placed in the chuck, *e*, in a proper position, as shewn in fig. 2; and the collar, *f*, is to be screwed on, which will have the effect of fixing it firmly, by the collar pressing upon the outer part of the cone, *n*; and as that cone is cleft or divided into four portions, it will spring and yield to the pressure given by the collar, and thereby hold the point immoveably. The handle of the etching-point is then to be passed through the mandrel, until the outer screw, *s*, of the chuck, *e*, comes into contact with the screw at the end of the mandrel, into which it will enter; and the whole will be then combined, as shewn at fig. 2. The string of the bow is now to be placed upon the pulley, *g*, of the mandrel, and worked with the left hand; a slip of Turkey oil-stone, with oil upon it, held in the right hand, must then be placed in contact with the etching-point; and as the bow is drawn down, the slip of stone is to be advanced forward; and this movement is to be repeated at each descent of the bow, by which means a beautiful conical point will be produced on the end of the etching-point or needle; and the angle of which may be made more acute or obtuse, according to the angle which the surface of the stone makes with the axis of the needle or point.

Where the sizes of the etching-points vary very considerably, it will be better to have two or three chucks, with the internal portions, *d*, *e*, that hold the points, different in size; all the other parts being the same as in the one already described.

If the slip of Turkey oil-stone be held very steadily at the same angle, and advanced forward as the drill-bow descends,

it will produce a very perfect cone at the extreme point of the etching-needle, a figure of which is represented as magnified, at fig. 7. Such a point is fit for executing that department of the art commonly called *dry-pointing*. But as etching, to be done upon copper when covered with a coat of varnish or etching ground, requires, in many instances, to be executed with a more free and playful needle (especially in the case of foliage, or similar subjects), the shape seen at fig. 8, is most generally preferred; and which may be as perfectly produced as a cone, provided that the slip of oil-stone be made to vary from a fixed angle, at and during each advance or stroke of the stone.

All manipulations of this kind require a slight degree of practice, before a proper degree of readiness is obtained: but the great incitement to overcome any little difficulty, will be the impression upon the mind, that, when the object is once attained, it will at all times afterwards become a matter of certainty and ease. Where a thin slip of oil-stone cannot readily be obtained, a flat piece of iron, about an inch broad, may be used in the same manner, and with equal advantage, if the surface that is used to grind or sharpen the point has a little Turkey oil-stone dust mixed with a little olive oil spread upon it: the method of using it, when so prepared, is precisely the same as with the slip of stone, before described.*

I am, dear Sir, your's sincerely,

E. TURRELL.

[*To be continued.*]

LXIII.—*On the Cultivation of the American Cranberry in dry Beds.* *By* ROBERT HALLET, *Esq.* F.H.S.†

HAVING cultivated the *American Cranberry* with great success in Devonshire, I beg leave to submit to the Horti-

* A piece of plate glass is also well adapted to this purpose.—EDITOR.

† From the Transactions of the London Hort. Society, 1822.

cultural Society a detail of the practice by which I have satisfactorily ascertained that the fruit of this plant may be obtained in *dry*, as well as in *moist situations*, to any extent that may be desired: and since it makes such excellent tarts, and as no other trouble is required to preserve the berries for winter use, than putting them into dry bottles, and corking them up close*, I trust this communication will be acceptable.

In April, 1814, I procured four plants of the American Cranberry (*Vaccinum macrocarpon*), the kind cultivated by the late Sir JOSEPH BANKS, at Spring Grove, whose method, as given in the *Transactions of the Horticultural Society*†, I followed; placing them in a small bed over part of a pond which was fenced off. These plants flourished, and produced me some very fine fruit, which I found so useful, that I was induced to attempt to obtain if possible a larger supply; but not having another piece of water which I could conveniently devote to this purpose, I resolved to try to grow them on a dry bed.

In April 1818, I filled half a dozen shallow boxes, each about eighteen inches square and four inches deep, with peat earth, and planted in them, at one inch apart, cuttings‡ of the Cranberry, about an inch and a half in length, placing them in my melon-bed, where they were frequently watered; the cuttings rooted freely, and threw out strong shoots; and in the June following they were fit to plant out.

Having collected from a dry hill, where wild Heaths flourished in abundance, a sufficient quantity of peat earth, such as CUSHING in his *Exotic Gardener*§ describes under that name, I formed a bed one hundred and fifty feet long,

* Those berries keep best which are not over-ripe when gathered.

† Vol. I, p. 75.

‡ The cuttings may be taken from any part of the old plants, for the old wood will root equally as well as the young branches.

§ Second edition, p. 156. The peat earth used had no part of the turf or sod in it; that had previously been taken off to the thickness of about two inches, and dried for fuel.

by four wide. In order to give the plants room to extend their roots freely, I caused eighteen inches in width in the centre part of this bed to be excavated throughout its whole length, to the depth of two feet; and having first covered about two inches of the bottom of the trench with small wood, I filled it up with the peat earth, well trod in: on the sides of the bed, to the extent of its width, I put only six inches depth of this mould. About the end of June 1818, I placed one row of plants in the centre of this bed, and about two feet‖ apart from each other in the row: these soon put forth luxuriant runners, extending before the winter to the edges of the bed. At the close of the year 1819, the bed was covered with the plants, and the runners of the former year had thrown out a number of upright bearing shoots, from which, last year, I gathered several bottles of excellent fruit, much superior in flavour to any imported berries I have ever tasted. In the autumn of 1820, I had the satisfaction to see the entire bed filled so completely by the plants, as to form a mass through which scarcely a weed could penetrate, the whole exhibiting a profusion of bearing branches, which are now (May 1821) putting forth such an abundance of blossoms, as not only to make a very handsome appearance, but to promise a supply of berries far exceeding my expectation. On the margin of each side of the bed I planted a double row of Bilberry or Whortleberry plants¶ (*Vaccinum Myrtillus*), which are equally thriving and full of blossoms.

The cultivation of the American Cranberry, as practised at Spring Grove, must be very limited; for few persons have pieces of water which they could conveniently appropriate to that purpose: but by following my method, an ample supply may be obtained at little trouble or expense, wherever a bed of peat earth can be formed.

‖ If planted four or six feet apart in the row in the centre of the bed, the shoots would soon meet.

¶ These are no ornament to the bed, and were planted in it merely as an experiment.

The plants, after the first supply, may be easily propagated to any extent that may be required: for though they root freely under glass, yet a hot-bed is not absolutely necessary to raise them. I have known the cuttings strike well, and make good plants, in pots in the open air; and after being rooted, they require no trouble to preserve them. One of the boxes of those raised in 1818, has been left exposed to the open air throughout three summers and as many winters; and though no care was bestowed on the plants, and the depth of earth did not exceed four inches, yet neither the summer's heat, nor winter's cold affected them; and last year they produced some very fine berries. This proves their hardy nature, and that an exposed situation will not be inimical to the health of the plants. The berries I have likewise found to be as little susceptible of injury, from being allowed to remain out late in the season; for on examining my bed in April last, I discovered that, of a considerable number which had not been gathered in the autumn, many were at that time in a perfect state on the branches.

Four feet is the most convenient width for the beds; but by passing the shoots under a path formed of peat earth, wherein they shoot, other beds might soon be established on each side. From four to six inches depth of peat earth would be sufficient for such beds, and the paths should be level with them; it being desirable not to drain off the moisture.

Dry heathy commons and wastes would produce a large supply of these fruits, with little labour or expense, either for the markets, or for food for moor game*. A single plant would soon extend itself over a large space of ground, if turned up and kept clean till the runners had taken

* Several gentlemen in the west of England are anxious to cultivate the American Cranberry extensively, for the purpose of food for grouse, or red game, which they are very desirous of introducing on their heaths and moors; and these birds, by dropping the seeds, would, no doubt, assist in propagating the plants.

root; and as no manure is requisite, and little or no weeding wanted, the first trouble is all that would be necessary, except in situations where hares or rabbits abound; these animals are particularly fond of the young plants, and a temporary fence must be made to protect them from their depredations.

Dung is particularly injurious to the cranberry; it absolutely destroys it, as I have proved by a variety of experiments; in which I found that all the plants completely failed which were planted in any compost of which garden mould or dung formed a part. Peat earth is the only soil in which they will flourish: nor can a supply of this very valuable fruit be expected, except in situations where the plants will have a due enjoyment of sun and air.

NOTE BY THE SECRETARY.—In the autumn of the present year (1821), Mr. HALLET sent to the Society a plant removed from his bed of American Cranberries, which, both by the luxuriance of its growth and the abundance of its berries, satisfactorily proved the possibility of producing this fruit in perfection in *dry* situations.

LXIV.—*On Turning Hardened-steel Necks, or Pivots, with the Diamond; and on the Employment of Pewter Collars for them to run in.* By Mr. JACOB PERKINS.

IN consequence of the suggestion contained in our article "*On reducing Friction in Machinery*," in our last Number, p. 190, Mr. Perkins has been kind enough to inform us of the method actually practised by himself in America to effect the important object of turning hardened-steel.

He states, that it is absolutely necessary, in the first place, to have a lathe of a sufficient weight to ensure the steadiness of the cut; and that it must be most accurately finished, and well fitted in every respect; that the motion of the hardened-steel body to be turned, must be very swift;

and that the diamond must be carried along in a guide-rest, with a very slow motion.

He likewise shewed us a heavy lathe mandrel, turning in a collar of pewter; and also that he had fitted a cast-iron band-wheel for another lathe, upon the square of its crank spindle, by first accurately adjusting it, and then filling up the space between the two with melted pewter.

We are glad to be able thus to furnish our readers with the necessary requisites to perform the difficult, though highly beneficial operation of turning hardened-steel pivots; and likewise with additional proofs of the utility of employing pewter for the lathe collars.

LXV.—*On the Employment of Charcoal made from the Wood of the Elder, in polishing Brass, Copper, and Decarbonated Cast-Steel. By the* EDITOR.

IN a small Treatise on Varnishing, Lackering, &c. published some years since, the charcoal of elder was particularly recommended to be used for polishing brass, previously to lackering it. On lately mentioning this circumstance to Mr. Jacob Perkins, he immediately shewed us some elder charcoal, carefully made by himself, and which he employed in polishing the surfaces of his decarbonated cast-steel blocks &c., in preference to any other. Mr. Turrell has also since informed us, that the best charcoal he had ever met with, for polishing engraved copper-plates, was a small piece furnished him by Mr. Perkins:—there is no doubt, therefore, that the knowledge of this excellent charcoal will be beneficial to many artists and others, employed in polishing these metals.

We are informed that the wood of the elder is very commonly used by rule-makers, in place of box: and as it is desirable to employ it in the seasoned state, it may, no doubt, be had of them. It may be readily converted into charcoal, by cutting it into short pieces, and putting them into a crucible, sufficiently deep to allow them to be covered

with about four inches in depth of fine sand or loam: this may be placed in a kitchen fire in the evening, and be allowed to remain therein all night; next morning it will be cold enough to remove, and the charcoal may be taken out for use.

Willow truncheons, converted into charcoal, are preferred by the copperplate makers for polishing. We have found that the charcoal of elm is equally fit for the purpose, when made in the manner above directed. It should be used first with water, when it cuts rapidly; and afterwards with oil, to polish with. It should also be held at an angle of about 45° to produce its proper effect in polishing.

LXVI.—*On the most economical Method of employing Fuel in heating the Flues of Forcing-houses. By* THOMAS ANDREW KNIGHT, *Esq. F. R. S. &c. President of the London Horticultural Society**.

IN cultivating the pine-apple without the aid of any other artificial heat than that derived from the flues†, I have endeavoured to ascertain by what means a high and regular temperature can be best maintained with the least consumption of fuel, and the expense of attendance; and I have succeeded so well, by the following method, that I think I can with confidence recommend it.

I caused coal, in a state of dust, and of a kind which does not unite when heated, to be incorporated, when very wet, with about one-third of its bulk of clay, or pond-mud; and this composition, after being firmly beaten together upon a broad flat stone, or board, to the requisite degree of thickness, was cut into square pieces, of the size and form of half a common brick. A fire-grate of the usual form, but of large size (about two feet square), was prepared to receive it, it being expedient that the fire-place should contain a large mass of materials of slow combustion: and as the

* From the Transactions of the London Horticultural Society, 1822.

† See p. 157 of this work.—EDITOR.

coal dust, in the wet state above mentioned, does not readily ignite, a sufficient quantity of wood to make a moderately strong fire was previously introduced. The masses of clay and coal were then put in by means of a small iron plate with a long handle; and no other material has subsequently been found necessary. The quantity of coal dust consumed during the coldest weather of the last winter (1819), was between seventy and eighty pounds weight in every twenty-four hours; and I consider the aggregate expense to have been about seven-pence a day; the price of the coal delivered being ten shillings per ton; and the value of the burnt earth, as manure, being fully equal to the expense of the preparation. Newcastle coals would consume much more slowly, and in an equally quick draft would probably admit the mixture of a larger proportion of earth. It is scarcely necessary to add, that the foregoing practice will be found most advantageous, where the price of coals is highest.

The fire in my hot-house, in the most severe weather of the last winter, was constantly made up for the night before five o'clock in the evening, and it was never again visited till seven o'clock the next morning, when it was always found in a state to afford fully sufficient heat to the house, which is forty feet long by twelve wide, and heated by a single fire. But it sometimes happened, after a windy night, that the structure of the masses of clay and coal had been wholly destroyed; and in such case, when the weather was very severe, it was found expedient to introduce a small quantity of faggot-wood, or decayed pea-sticks, between the ignited mass and the fuel put on in the morning.

It will probably at first view be thought, that the clay or pond-mud, in the case above stated, operated beneficially in no other way than by preventing the too rapid consumption of the coal; but I believe that it executes a more important office. It is well known in countries where wood is chiefly used as fuel, that a mixture of dry and green wood affords much more light and heat during combustion, than an equal

bulk of dry wood; and I was long acquainted with the circumstance before I was in any degree able to conjecture the cause of it: but I have subsequently attributed the increased production of heat and light by the intermixture of green and dry wood to the decomposition of water; the oxygen of which readily combines with charcoal in a red heat, whilst the hydrogen becoming disengaged, burns when it comes into contact with the atmospheric air: and upon subjecting the experiment to the inspection of Sir HUMPHRY DAVY and Mr. PEPYS, they both agreed in attributing the increased strength and brightness of the fire to the decomposition of the water which exhaled from the green wood.

The mixture of coal-dust and clay being always placed upon the fire in a very wet state, necessarily discharges a large quantity of water in the state of steam; part of which condenses in the cooler parts of the flues, where it is probably absorbed in a considerable quantity by the bricks, and exhaled into the house; for I have often found the sides of the flues to feel damp. My hot-house, therefore, though apparently a dry stove, is not really such: and possibly the exhalation of moisture from the flues, may be the cause why my pine-plants have thriven so much better in very high temperature, than such plants are said to have usually done, in those forcing-houses which are properly called dry stoves.

LXVII.—*On Lubricating the Sliding Parts of Morey's Revolving Steam-Engine; and on an Improved Steam-Boiler.* By J. L. SULLIVAN, *Esq.**

To PROFESSOR SILLIMAN.

SIR, *Columbia, S.C. March* 1, 1822.

HAD I no other motive to offer you a further communication on *Morey's Steam-Engine*, I should think it due to your Journal, in which an account of this form of the

* From *Silliman's American Journal of Science and Arts*, Vol.V. No.I.

machine had been given to the public at an early period, to state the fact of its successful employment: but I find a further reason for doing so, in the opinion expressed by Mr. Ward, in your fourth volume, while describing *his* invention*. He fears that Morey's engine will not be durable; because, as he thinks, the friction between the parallel guides, and the brasses that move on them, will be such as to affect the parallelism of the piston-rod. This was to assume, that it would be impracticable to apply any *anti-friction* substance to this part of the machine. But, in practice, nothing was easier than to attach to each side an *oil-box*, with a few small holes on the top thereof, covered with a sponge; which, as the engine revolves, imbibes the oil, while the brass at each stroke reaches, and a little compresses this sponge, so that the steel guide-pieces are continually lubricated. And thus far it has performed satisfactorily, ascending the Santee and Congaree rivers, towing heavy loads against a strong current. We call the steam-boat in which this engine operates, *the Patent*, in allusion to her claim or right to navigate the waters of New York, notwithstanding the monopoly granted by the State; it being an admitted point, that the laws of the United States are the paramount authority;—wherefore, patenteed operations cannot be legally excluded.

But Mr. Ward's apprehension is shewn to be unfounded, by the performance of an engine of this kind, during the last three years, at a manufactory near Boston, even without this precaution.

Unwilling to occupy your pages with this familiar subject, I will only add, that it appears to have been the object of Mr. Watt's experiments, to *avoid the use of the crank*, as involving the *necessity* of a fly-wheel, to which motion must be given, at some expense of power, at every stroke. If I am not mistaken, the double revolving engine is effectively a rotary engine. It has no dead-point, and requires no fly-wheel; and it is so far different from those engines

* See Vol. II. p. 4, of this work.—EDITOR.

which work with a heavy beam, that the indispensable weight of the machine has a degree of momentum that contributes to the steadiness of its operation. It appears to me, that to produce the same effect, Mr. Ward must place two cylinders in each water-wheel, at right angles.

Since this occasion of addressing you occurs, permit me to avail myself of the opportunity to describe an improvement in the steam-boiler, put in practice in this boat, to combine strength with horizontal extension, in order to afford a great extent of surface to the action of the fire, and yet carry a light load of water.

I took the materials that would have made a boiler of eight feet in diameter, and seventeen feet long, and formed of it seven cylindrical vessels; having conical heads, terminating in flanches, to which are attached a cross connecting pipe, thus making one boiler of them. The (high-pressure) steam rises from the centre of each (through pipes), into a common chamber, on which the safety-valve and throttle-valve are situated. The support is from four semicircular irons, or arches, from which suspending irons descend, &c. The spaces between are filled with brick-work. The flue passes under them above deck: its sides and floor are formed of water vessels, kept full by the surplusage of the supply pump, for which they prepare the water; under the grate, however, there is an air-chamber, formed of two thicknesses of sheet copper; the space between them being also supplied with water; this descends a few feet into the hold, and its bottom forms a pan, into which the cinders fall. The floor of the fire-room is on this level, and being half above and half below the level of the deck is open to the air.

When half full it contains about three hundred gallons, but the fire is in large proportion. The steam appears to form very quickly. The advantages of the conical heads are, that instead of being the weakest, they are the strongest parts of the boiler, and within the rules of computation.

I am, respectfully your's,

J. L. Sullivan.

LXVIII.—*On the Formation of Flexible Elastic Tubes, of Caoutchouc. By Mr.* Thomas Skidmore*.

To Professor Silliman.

Sir,

I have lately had occasion, in the practice of the Arts, to make use, in a modified manner, of the compound blow-pipe of Hare, supplied with oxygen and hydrogen gases; and in doing so, have been compelled to seek for some material, of which I could make a flexible elastic hose or tube, indispensable to my operations.

Leather, in various ways, was used without success. The intestines of the hog and bullock, in their natural state, answered the purpose tolerably, for a short time; but they soon cracked, and exhibited fissures, through which the gases escaped very fast—and, on being tanned with an infusion of sumach, became very porous; notwithstanding they were surcharged with oil, tallow, &c.

At last I imagined that Caoutchouc, or India-rubber, might be employed with a prospect of success; and, as I obtained it, it may possibly be of some importance to your readers, to be made acquainted with the process, I followed in its manufacture—which is as follows:

I caused small iron-wire to be coiled spirally around a cylindrical rod of iron, as close as it could be laid, of the length, in one instance, of twelve feet. The extremities of this spiral coil were then made fast to the rod (after having been once loosened from it,) in such a manner, that in the subsequent operations, the convolutions of the wire should remain in contact with each other. Over this coil was wound spirally, a covering of tape, ferreting, or other fabric, so as completely to invest it; and, in the process shortly to follow, to prevent the intrusion of the rubber into the cavity of the spiral coil before mentioned.

* From *Silliman's American Journal of Science and Arts*, Vol. V. No. I.

The rubber was now taken, as it is sold, in the form of bottles, and cut spirally into long narrow strips. This is best effected, by first cutting them into two equal parts, and then reducing them, as near as may be, into circular plates, with a pair of sharp tailor's shears, which answer this purpose much better than would probably be imagined. These strips are wound in a spiral manner, over the covering of tape or ferreting above mentioned, from one end of the coil to the other; and this was twice repeated, care being taken, to lay, as far as was practicable, the fresh-cut surfaces of the slips in contact with each other, and drawing them so tightly, as to cause them, from their elastic property, to stretch to two, three, or four times their original length. When this was done, another covering of strong tape, (linen is to be preferred,) was laid spirally over, or around the rubber, from end to end, and secured upon it, by winding very strong twine as closely upon it as could be done, and drawing it as tightly as this material would permit. The rod of iron was then withdrawn; and the recently-formed hose was bent into a circular form, small enough to enable it to be put into a vessel of water, in which it was boiled for an hour or two, when it was taken out, the external coverings taken off, and the internal spiral wire and tape withdrawn.

This latter operation, at first, gave me some trouble, in consequence of the stiffness of the wire; but in preparing other tubes of the kind, this difficulty was overcome, by previously annealing the wire.

In the course of my experience, I found, that if the hose so prepared, be subjected to a second boiling, it has the effect of reducing its size considerably; so that if this second boiling be contemplated, for instance, to unite two pieces of hose together, this circumstance should be taken into account.

I know very well, that it has been stated, that tubes or hose have been made of this material, upon glass or metal rods; yet, as I was unable to succeed in that way, in pieces

exceeding four inches in length; I concluded, that where twice or thrice that number of feet were wanted, the method was impracticable; and therefore pursued the one I have detailed. The result was, as you may well conceive, a hose perfectly elastic; and which, although not very elegant on its exterior, yet it is very light, and perfectly impervious to the gases which it conducts to the blow-pipe it is attached to.*

I am, Sir, your's, &c.

THOMAS SKIDMORE.

LXIX.—*On the Cultivation of Chinese Chrysanthemums. In a Letter to the Secretary. By Mr.* JOSEPH WELLS, *Gardener to* WILLIAM WELLS, *Esq. F.H.S.*†

SIR,

IN consequence of your commendations of the *specimens of Chrysanthemums*, which I had the pleasure of shewing you lately, and of your desire to be informed of my mode of treating the plants, I now submit an account of my practice to you.

In the last week of May, or early in June, I take cuttings of the plants, five or six inches in length, and plant them under a north-wall, placing a hand-glass over them. When they have struck root, it is necessary to admit a little air to them, to prevent their being drawn up weak. In a few days after they are well rooted, I take them up, and plant them singly in as small pots as they can conveniently be put into, shading them until they have recovered this removal: I then select an airy border, at a distance from any wall or building, into which I plunge the pots up to their rims; the plants will speedily fill the pots with roots, which will also soon extend over the rims. It is then neces-

* A specimen of the tube is in our possession, and perfectly answers the description.—(*American Editor.*)

† From the Transactions of the London Horticultural Society, 1822.

sary to raise and re-plunge the pots; this checks the too rapid growth of the young plants.

Whilst in this border, they require to be watered pretty freely. When they begin to put forth shoots, I determine on the number of those I wish to retain, which is usually about three. I pick off all the others, and never suffer more to grow either from the stem or from the roots.

Early in September, I shift the plants into thirty-two sized pots, using rich mould in the planting: they are not again plunged, but kept in an airy part of the garden, until frost or bad weather obliges me to remove them into the conservatory. After the shifting, I water them occasionally with rich liquid manure, the drainage of a sewer, and which is composed of soap-suds, and other matters. When they begin to shew for blossom, I examine them at different times, and by thinning, reduce the number of flower buds.

The advantages resulting from the above mode of treatment are, that the flowers are large and the plants dwarf, not being higher than from two to three feet; they are besides full of large, perfect, healthy leaves. Neither am I under the necessity of preserving so many old plants through the winter; for two or three of each sort will produce abundance of shoots, after the flowering stems are cut down, to furnish cuttings in the spring.

I have adopted the above practice for three seasons: the addition of the liquid manure, I have used this season at the suggesion of a Chinese, who informed me that it is constantly employed in the cultivation of this plant in China.

The plants, when treated as I have described, are very different in their appearance from the Chinese Chrysanthemums, as usually grown; they have no shoots from the roots, which allows the strength of the plant to go to the blossoms; a single stem rises from the pot; and at the height of four or five inches, branches off into two, three, or more

flowering stems, from one to two feet long, terminated by large flowers, and covered in their whole length by vigorous foliage.

I am, Sir, your obedient humble servant,

JOSEPH WELLS.

Redleaf, near Tonbridge,
December 2, 1821.

LXX.—*On the Preparation of Acetate of Alumine**.

THIS combination is much employed in dyeing, and calico printing. It has been substituted, and in many cases with advantage, in place of alum (sulphate of alumine and potash,) because its elements are united by a less powerful affinity; and the colouring matter and the cloth subtract the alumine from it more readily, and which serves to unite them reciprocally, as a mordant.

We obtain this acetate by the double decomposition of alum, and an acetate whose base forms an insoluble salt with the sulphuric acid. The acetates of lime or of lead are of this description; but the latter is most commonly used. We dissolve here two salts separately, and in the cold. We afterwards pour, by little and little, the solution of alum into that of the acetate of lead: we then strongly agitate the mixture, and leave it to settle. The sulphate of lead very quickly precipitates in the form of a white powder, and the acetate of alumine remains in solution: we decant and filter as required.

The numbers according to which we may find the proportions necessary to effect this reciprocal decomposition, are the following:—

100 of acetate of lead contains.	.	58 oxide
100 of sulphate of lead contains	.	73,68 oxygen 26,82 oxide;

from whence we deduce that these 58 of acetate of lead

* From the *Dictionnaire Technologique.*

require 20,71 of sulphuric acid for their saturation; but the common alum with potash contains, according to Berzelius, 34,23 of acid, to 100 of alumine. It follows, then, that the proportions rigorously necessary to complete their reciprocal proportion, are,

100 acetate of lead
60,5 alum.

We generally add a little excess of alum, that we may be quite certain that there remains no acetate of lead in the liquor, which would be very prejudicial in certain cases.

We must here remark, that if we would obtain the acetate of alumine for a re-agent, that is to say perfectly pure, we must, near the end of the precipitation, make continual trials, by means of successive additions of each of these solutions, to arrive at that point in which neither one or the other produce any turbidness in the mixture. The acetate of alumine will not crystallize: we cannot proceed beyond a certain degree of concentration, without separating the acid necessary to the saturation of the base. This solution has the singular property of becoming turbid by heat, and of becoming clear again on cooling. We attribute this phenomenon to the dilatation produced by the elevation of the temperature; however little, it is sufficient, in this case, to determine instantly the separation of the elements of the acetate, which are only united by a very slight degree of affinity; the molecules approach on cooling, and combine anew.

LXXI.—*On Iron and Steel. By the* Editor.

[Continued from p. 132.]

On an improved method of softening or annealing cast-steel.

It is very singular, that cast-steel should be *softened* by the very same means which are ordinarily employed to *harden* it; and yet such is the fact.

We have constantly seen, that those parts of the stems

of drills which immediately adjoin to the hardened points, are found to twist much more than any other parts; and also, that those parts of chisels, punches, &c. which are next to their hardened edges or points, are exceedingly liable to bend, unless they have been made much stronger than would otherwise have been requisite. Yet, notwithstanding that these facts were continually presenting themselves to notice, it does not appear that any use has been made of them, by workmen in general.

Some judicious persons, however, have availed themselves of this singular property, and with great advantage; as by it they are enabled not only to anneal cast-steel in much less time than by any other method, but also to free it entirely from those hard spots, usually termed *pins*, which occasion so much trouble to workmen in filing or turning it.

The process consists *in carefully heating the steel, nearly to the hardening point, and instantly quenching or cooling it in water; and the nearer that heat approaches to the hardening point the softer the steel will become.*

Cast-steel articles ought always to be thus annealed previously to planishing them, or condensing them by hammer-hardening; and it is wonderful how much they will stretch under the hammer, after being so treated.

Even re-cast wootz (or East-Indian cast-steel) may be thus planished, when cold, with the greatest ease, and with a very considerable improvement in the quality of the articles made of it; provided due care has been taken not to overheat it in the working of it into form, and that it be carefully hardened with the same precaution.

In our Miscellaneous Article will be found an account of the very extraordinary properties of the fine cutlery made of French Damascus steel, by M. Henry de Besançon, at Paris. If they are such as are represented, we know of no process so likely to produce such wonderful effects, as this is.

We have in our last article "*On Iron and Steel*," p. 182,

indicated the means of obtaining the great requisites of hardness and strength, in the points or edges of tools formed of cast-steel. It can hardly be necessary to point out to our readers the advantage of annealing them previously to hammer-hardening them, by the process now given. And, indeed, we are indebted to the same excellent workman, Mr. Stancliffe, for this process, as well as the former one, who obtained it from a Lancashire file-maker.

The Lancashire watch and clock-tool manufacturers are indebted for the knowledge of their superior processes, to a colony of persecuted Huguenots, from Geneva, who brought over with them the excellent methods practised in their own country:—and even now, many of our best workmen are to be found amongst their descendants.

LXXII.—*On the Slaughter-houses at Paris**.

These are termed *Abattoirs*, where the animals are knocked down and slaughtered, for the consumption of the city of Paris. A few years since every butcher killed his beasts on his own premises. Not only were the streams of blood disgusting to the sight and smell, but the putrid miasma exhaled at certain seasons of the year, from the heaps of animal substances, tainted the air of the surrounding neighbourhood, and thus became the vehicle of infection. But besides this, it often happened, that the beast, struck by an unskilful arm, broke its cord, forced its way, and furiously ran about the streets, to the danger and annoyance of the numerous population of the capital.

Administration has wisely seen the necessity of removing this important business to the suburbs of Paris, in order that it may be effected in open and airy situations, and where there are fewer inhabitants. *A like reform is desirable in all great cities, and doubtless it will not be long before it takes place.* But it is not so much on account of promoting health and the public safety that we are now consi-

* From the *Dictionnaire Technologique*.

dering the *abattoirs*, as the facility which is given to the collecting of the many animal substances which are employed in the arts. The manufacturers of glue, gelatine, Prussian-blue, neats-foot oil, &c.* derive numerous advantages from this regulation. Many of these businesses can only be carried on in the vicinity of large cities, where the great consumption affords an opportunity of disposing of large quantities of bones, horn, blood, intestines, &c. and which are carefully collected, to be employed in the arts.

We shall now proceed to give an account of the construction of these *abattoirs*, of which there are five, formed nearly on the same plan.

Many ranges of buildings are enclosed within the same walls: two double rows of these buildings are contained in one yard or court, which is paved with stones; the water used for washing the premises, is supplied by pipes, and afterwards runs away by means of a descent or gutter in the pavement. The two ends of this court are closed with iron railings; at one end the living animal enters, and is immediately shut up.

Each row of *echaudoirs*, or slaughter-houses, is divided into nine equal spaces, separated by walls. The space in the middle, however, is reserved for the stairs which lead to the top of the building. The eight other spaces are the *echaudoirs*. Two rows of buildings then contain sixteen *echaudoirs*; there are eight rows of buildings (64 *echaudoirs*) in the *abattoirs* of the department of Montmartre and Menil-Montant; six, in that of Grenelle (forty-eight *echaudoirs*); and four, in those of Roule and Villejuif (thirty-two *echaudoirs*). Every *echaudoir* has two doors; one, which opens into the inclosed court, for the beast to enter; the other, opening towards the front of the inclosure, by which to

* The products which are extracted from the bones, horns, hoofs, and the blood of animals, are of great importance in the arts. The blood is beaten up as it runs from the body of the animal, to prevent the constituent parts of it from separating; it is used in dyeing, in refining sugar, and in the manufacture of Prussian blue. The nutritive gelatine, so useful in hospitals, and in navigation, is extracted from bones, &c.

take out the animal after being cut up. All these doors are carefully shut, to avoid accidents; besides which, the whole of the inclosure is surrounded by walls, on the top of which are very high rails, so that even a mad ox could not possibly break through them.

In order to slaughter the animal, they tie round his horns a strong cord, which is also passed through a ring firmly secured into the stones which pave the floor; they then draw down the head of the animal close to the ring, and while one strong man holds the cord, another strikes him on the forehead with a heavy iron club; the stunned animal falls, they then stab him, for the purpose of making him bleed.

We must own that this savage manner of putting an animal to death makes humanity shudder; if it be requisite for the nourishment of man, that animals should be slaughtered, the means of effecting it ought to possess the least possible cruelty. This method calls for reform: but, without dwelling on the subject, we will finish by observing, that as soon as the ox is dead, they insert under the skin, the pipe of a large pair of bellows, by means of which they inject into the entrails a large quantity of air, to inflate the membranes and give the meat a better appearance. They next take off the skin, and separate the different parts of the animal.

All these operations are performed on the pavement of the *echaudoir*. A crane is provided in each *echaudoir*, for the purpose of drawing up the cord by which the animal is suspended to the ceiling, by the assistance of pulleys. A tub is also let into the floor, (which has a descent,) for the blood to run down into, and which is collected for various purposes. Two pieces of wood are placed horizontally at the height of seven feet, one end of each of which is secured in the wall; to the outer-ends are affixed a transverse cord. It is on these supports that the parts of the ox are hung, when they have received all the dressings, to wait the time when they shall be taken away, and sold for consumption.

For the salubrity of the *echaudoirs* frequent washings are necessary, and a great abundance of water is required. This is drawn from a cock fixed to a large reservoir, and is distributed every where by leaden pipes. This water is raised by a steam-engine: that at the *abattoir* at Montmartre was executed by M. Saulnier, an expert mechanic in the Mint. The description of this machine is given in the Bulletin of the Society for Encouragement, for May, 1821; and this Society has rewarded M. Saulnier by a silver medal. It results from the report of M. Baillet, that this machine has the power of four horses (525 cubic metres of water being raised at the rate of one metre per hour); it consumes 32 kilogrammes of pit-coal per hour; or we may estimate that two kilogrammes of coal raises 29 cubic metres of water, one metre high. This water is raised 42 metres high, in a single jet. The quantity of water required for 64 *echaudoirs*, is 20 cubic metres per day, on account of the Tripery; which amounts to 60 cubic metres for the supply of the 240 *echaudoirs* of the city of Paris.

At the *abattoir* of Grenelle, we admire the ingenious machine of M. Manoury d'Hectot, which has been made the subject of an interesting report by M. Girard, of the Academy of Sciences.

The rule is, to allow to every butcher his own *echaudoir*, (unless the extent of his business requires him to employ two): nevertheless, many butchers unite in the occupation of the same *echaudoir*, and divide between them the expenses and profits. These expenses are limited to six francs for each ox, besides the ordinary *droits d'entrée et octroi*, *&c.*

According to the Statistical Table, published by the Prefect of the Department of the Seine, the number of oxen required for the annual consumption of the city of Paris is 71,750, besides 8,500 cows; these numbers are the average of ten years observations. The number of beasts slaughtered at Montmartre and Menil-Montant, is then

about 21,000 per annum for each establishment. In the *abattoirs* of Roule and Villejuif, they have only killed 10,600; in that of Grenelle, 16,000 per annum.

Within the inclosure of each *abattoir* are other buildings, for the residence of the governor and those employed under him, to take care of the concerns of the establishment; and also large pens, serving to contain the beasts, till the time of slaughtering them. As they also slaughter calves and sheep, there are very airy sheds provided, where they are fed. Each *echaudoir* has its pens.

Over the shambles are large lofts for the temporary use of the butchers, to deposit their skins, &c. in.

Other buildings are used to melt the fat in; for the tripery, &c. &c. F.

REMARKS BY THE EDITOR.

We have inserted this interesting article, with a view of awakening the attention of our readers to the admirable example set us by our neighbours on the Continent. How much of the continual mischief daily arising from the savage practices of bullock-driving and hunting, would be prevented, by our adopting so wise a regulation. We sincerely wish that Parliament would compel its adoption, both in this metropolis and in the other large cities and towns of the United Kingdom.

LXXIII.—MISCELLANEOUS.

Fatal Explosion of a Steam-boiler.

On the 17th of last month, about five o'clock in the afternoon, a Steam-boiler burst at the Patent Glue Manufactory of Messrs. Yardley and Cleaver, Wells-Street, Camberwell; whereby two men were killed, and five others seriously wounded.

It appears by the Coroner's Inquest, which was held on

the 19th ult., from the evidence of John Sparks, the person who was attending the fire, that the two deceased persons were on the premises at the time; one of them was standing three yards from the boiler, and the other was coming in at the door of the house; the boiler was then at work at a pressure of *thirty-eight pounds* upon the square inch;—*it was warranted at one hundred and fifty pounds upon the square inch.* The boiler had had a new bottom put to it, and that was the first day of trying it, to see if it was sound. Mr. Haughton (query *Horton*), of the firm of Haughton and Fraser, who had repaired the boiler, was present to superintend the trial, with Buckridge his foreman, one of the persons who was killed. Mr. Haughton wished the boiler to be tried at forty pounds pressure on the square inch, and the witness was putting some fuel on the fire in order to raise it to that pressure; and while in the act of doing so, he felt the ground shake under him, at the time he was in front of the furnace; and being very much alarmed, he attempted to run away, when at that moment the rafters and joists gave way, which fell upon him and knocked him down; at the same moment he heard a great explosion. Thomas Denford, the other person who was killed, was the engineer's man; he was standing on an erection above the witness; and he, together with the floor, came down in consequence of the shock, and fell upon the witness. At this period the whole of the building was falling down, and the upper part of the boiler was blown off, several feet high, over a wall. Witness, on recovering himself, crept from under the rubbish which surrounded him, and proceeded to the assistance of the other sufferers. On getting into the yard, he heard the groans of Mr. Haughton, who was buried under a mass of bricks, timber, and rubbish; but he was soon got out. Buckridge, just before the explosion happened, observed that he would stand near the boiler, even if the pressure of the steam was at sixty pounds upon the square inch;—he was unfortu-

nately killed on the spot. Witness had worked at steam-engines before, *and this boiler was made in the same way as others were made.* The force of the steam and water dashed Denford against the corner of a wall, and he was severely scalded. Buckridge was quite dead; but Denford heaved a heavy sigh, and died almost immediately. The witness said that the weight of the boiler was estimated at about four tons; *it was never sound, it had a leakage, and was repaired, but it was afterwards unsound; on which a new bottom was put to it. This was riveted in the same way as others, but it was the new work that gave way.* They had the valves fixed to a certain pressure, and occasionally they were relieved. *Witness used his own discretion in the supply of fuel to the fire.* In the whole, five persons were injured, beside the deceased, and so seriously, that they were carried to the hospital.

Mr. Charles Yardley, (Patentee of a new process for manufacturing Glue from Bones, by means of high-pressure steam,) was next sworn. He appeared to be very much injured in consequence of the melancholy accident. He stated that on the day of the accident, he was at the manufactory viewing the operation; he was standing near the boiler when it burst, and heard a horrible noise, but did not consider it of serious consequence, until a mass of bricks fell upon him; then he anticipated all the consequences which arose from the accident. He was about six yards from the boiler, when the bricks commenced falling upon him, and he was obliged to run to save his life. Mr. Haughton was present when they were trying the boiler: he heard a rushing noise, which he thought was the steam. He ran to the extremity of the yard, and on turning round he perceived the whole of the building falling down. He heard the groans of Mr. Haughton, and saw him when taken out of the ruins. The deceased (Denford) was his foreman, and Buckridge was in the employ of Mr. Haughton, who warranted the boiler to bear a pressure of one hundred and fifty pounds on the square inch, when it was

brought from Birmingham. It had been much altered since.

The Coroner could attribute blame to no party. The circumstance of Mr. Haughton being present, and being injured himself, proved that he had confidence in the boiler, and that there was no intention of injury. Under the circumstances, the case could be considered in no other light than that of accident; but it was for the jury to determine.

The jury after a short consultation returned a verdict of—*Accidental Death, occasioned by the bursting of a steam-boiler.*

REMARKS BY THE EDITOR.

Independently of the loss of lives occasioned by this unfortunate accident, we must exceedingly regret it, as affording another instance of the gross ignorance in the employment of high-pressure steam in this country.

In America, the use of it is so well understood, that, notwithstanding the great employment of it there, an accident is very rarely heard of.

We expect, however, that this great ignorance will be shortly removed; as we understand that an American mechanic, well versed in the practice of that country, is about to introduce the use of high-pressure steam here.

There can be no doubt that great mismanagement, to say no worse of it, must have been manifested, in converting a steam-boiler, said to be originally warranted to endure a pressure of one hundred and fifty pounds upon the square inch, into one which burst at the comparatively low pressure of thirty-eight pounds only!

We must needs add, that we shall ever lament any obstacle being thrown in the way of employing high-pressure steam. Its advantages over steam of low pressure are great indeed. Steam-engines of great power and swiftness may be constructed of less bulk, and considerably lighter, than condensing engines; the expense of fuel is considerably less, and the quantity of water is less than that re-

quired for low-pressure engines:—all these advantages are of the highest importance, and particularly for the engines employed in steam vessels.

The highest pressure mentioned in the statements of the witnesses on the inquest, was only one hundred and fifty pounds on the square inch: now, in America, this is the very lowest employed; no steam under one hundred and fifty pounds pressure is suffered to enter the cylinder, and it is very frequently raised to two hundred.

We apprehend, from the statement of the witness, Sparks, "*that the boiler was made in the same way as others were made*;" that it was of the common form, or a waggon-tilt boiler; if so, we cannot wonder at its bursting; for, certainly, no form can possibly be worse for a high-pressure boiler. In America, the boilers are always made of a cylindrical form, of the very best wrought-iron plates, strongly riveted together, and either with conical or hemispherical ends; or, sometimes with flat ends of cast-iron, four inches thick; and, as the cylinders are of small diameter (not three feet) they are of course exceedingly strong.

The waggon-tilt boiler, on the contrary, is of a form exceedingly liable to expand and give way whenever any extraordinary degree of pressure is exerted within it; and this makes the boiler of a low pressure steam-engine of that form exceedingly dangerous. The steam-engine boiler which burst a few years since at the saw-mill in the Borough, and did so much mischief, was of that shape. It was originally intended for a condensing engine; but the proprietor, in spite of the repeated cautions of an experienced engineer, converted it into a high-pressure one, by first shutting up the safety-valve; and, the very day before the accident happened, the mercury having been blown out of the safety-tube, instead of replacing it, he plugged up the end of that tube; and our informant, the engineer, saw it on the morning of the explosion, in that state. He again renewed his cautions, but in vain; as in less than an hour afterwards the accident happened, the upper part and ends

of the boiler being rent from the bottom all round. The proprietor, (who had been keeper of the Marshalsea prison only six months before,) was so severely injured, that he died in a fortnight afterwards. Had he survived, he certainly ought to have been made an example of, to deter others from such nefarious conduct.

We are sorry to be under the painful necessity of adding, that, since the Inquest, two more of these unfortunate sufferers have died. We also learn that the boiler was of the waggon-tilt form, as we suspected.

Accident in Preparing Fulminating Silver.

Mr. Tuther, the optician and philosophical instrument-maker, of Holborn, in preparing this dangerous substance, on the 9th of September last, met with a serious accident, which at first threatened him with the loss of sight of his right eye; and from the effects of which he cannot, at any rate, recover for a considerable length of time. The nitric ether generated, by some means caught fire as it escaped at the mouth of the glass retort which he held in his hand, and communicating the flame to the contents of the retort, the whole exploded with a considerable report.

We mention this accident, with a view to caution our readers in the preparation and use of this highly explosive matter, and from which so many accidents have occurred; —too much caution cannot be taken to guard against mischief in treating it. Mr. Tuther, in spite of all his care, is an instance in point.

French Cutlery of Damascus Steel.

One of our most skilful and industrious cutlers, M. Henry de Besançon, whose establishment is in the Place de l'Echole de Medicine, at Paris,—having acquired the art of fabricating the steel called *Damascus*, very superior to that of Persia and Syria,—now employs it in making instruments of surgery, *which are far more valuable than those of*

English cast-steel. The extreme hardness and great elasticity of the Damascus, render it particularly important in the fabrication of instruments that require a very fine edge, such as razors, bistouries, lancets, instruments for cataract, &c. which so soon lose their edge, especially when used to pierce or cut very strongly resisting bodies.

We have seen lancets made by him pass through, with the greatest facility, pieces of parchment, and thin plates of lead, without any injury to the edge; whilst very good common lancets, treated in the same manner, were either broken, or so much dulled as to be unfit for use.* He fabricates, with his Damascus, all other kinds of cutlery, as knives, scissors, &c. with which bones, ivory, and even iron may be cut, without being dulled. The "Society of Encouragement," the New Journal of Medicine, and many other Gazettes, have spoken with much eulogium of these new and useful products of French industry.

Rev. Ency.

Signals for a great Distance.

—— SCHUMACHER, a captain of artillery, has invented a rocket which may become of great use to astronomers and geographers. They have a much greater force than the Congreve rockets, and ascend to a prodigious height. *When at their greatest elevation they explode, and produce in the air a volume of light so strong and brilliant, as to be distinctly visible at a distance of* 30 *leagues.* The inventor placed himself in the little Island of Hiveen, in the Catte-

* The properties of the lancets made of this Damascus steel are indeed very extraordinary, if they are capable of performing what is here stated! The usual test of the goodness of the point of a lancet, being, merely, to let it fall by its own weight, through a piece of the *cutis* of *fine kid-skin leather*, strained tight between the fingers. We insert this notice, especially, to stimulate our English artists to exert themselves in sustaining the high reputation they have hitherto enjoyed; and also, with a view to the truth or otherwise of this statement being enquired into by some Englishman at Paris, who may feel sufficiently interested in the welfare of the manufactures of his own country, to examine into the circumstances of this very extraordinary statement.

gat, and launched his rockets; whilst his brother posted himself at the observatory of Copenhagen, to notice the effect. Though the distance is nearly 30 leagues, he saw, by means of a telescope, the explosions appear and disappear, resembling stars of the first magnitude. It is impossible to imagine signals more beautiful, or more expeditious for great distances.

Bul. d'Encour.

LIST OF PATENTS FOR NEW INVENTIONS,

which have passed the Great Seal, since August 20, 1822.

To David Mushet, of Coleford, in the county of Gloucester, Iron maker; for his improvements in the making or manufacturing of Iron from certain Slags or Cinders produced in the working, or making of that metal. Dated August 20, 1822.—To be specified in six months.

To William Mitchell, of Glasgow, Silversmith; for a Process, whereby Gold and Silver Plate, and other Plate formed of Ductile Metals, may be manufactured in a more perfect and expeditious manner, than by any process which has hitherto been employed in such manufacture. Dated August 24, 1822.—In six months.

To Thomas Sowerby, of Bishopswearmouth, in the county of Durham, Merchant; for a Chain upon a new and improved principle, suitable for Ships' Cables, and other purposes. Dated August 29, 1822.—In two months.

To Robert Vazie, of Chasewater Mine, in the parish of Kenwyn, in the county of Cornwall, Civil Engineer; for improvements in the compounding of different species of Metals. Dated September 3, 1822.—In six months.

To Henry Burgess, of Miles-Lane, Cannon Street, in the city of London, Merchant; for certain improvements on Wheel-Carriages. Dated September 3, 1822.—In six months.

ERRATA.

Page 214, line 22, for *cliffs*, read *clefts*.

THE

TECHNICAL REPOSITORY.

LXXIV.—*Specification of the Patent granted to* ROBERT BENTON ROXBY, *of Arbour-Square, Stepney, in the County of Middlesex, Gentleman; for certain Improvements on, or Additions to, the Astronomical Instrument known by the name of the Quadrant.—Dated July* 31, 1822.

WITH A PLATE.

I THE said ROBERT BENTON ROXBY do hereby declare, that my improvements upon the instrument commonly called a Quadrant, are herein set forth and explained, reference being made to certain parts of the drawing hereunto annexed. But previous to describing the improvements I have invented, I shall here observe, that a great deal of inconvenience and difficulty is experienced by all mariners in the use of the Hadley's quadrant, on account of the liability there is in all of them to move by starts or jumps (particularly in damp weather); in which case it becomes exceedingly difficult, and sometimes almost impossible, to make an accurate observation, because the index so frequently overshoots the precise place at which it should come to rest. To remedy this inconvenience, a tangent screw was applied to the index or nonius, by which means a fine adjustment can be obtained: but in all cases where an observation is to be made, it is necessary that the index should be moved by the hand only, as near as possible to the desired position, when the index (in quadrants that have a tangent screw) must be clamped, and then the tangent screw is made use of to complete the observation. Now it must have been found

by every person conversant with nautical practice, that such a loss of time occurs in the use of the tangent screw, that the opportunity is frequently lost of observing the sun at the meridian, and that at a time perhaps when it is of the most serious consequence to the lives and property of a numerous body of people.

It also frequently happens, that when a view of the sun can be obtained while at the meridian, no use can be made of it, because the horizon cannot be perceived on account of the haze that then prevails. This unfortunate circumstance is too often experienced; and for want of an observation, the most distressing consequences ensue. Various attempts have been made to construct an artificial horizon, which should serve as well as the natural horizon: but up to the present time no one has been produced that would sufficiently answer the purpose, so as to be implicitly depended upon. I shall now proceed to shew how the improvements I have invented will enable any person to take a very accurate observation, whenever the sun can be seen at the meridian, whether the natural horizon be visible or not.

Fig. 1, Plate XI, A, A, represents a front elevation of a quadrant of the size that I prefer, when my improvements are to be combined therewith. B, shews a square plate of brass, screwed by the screws *a*, *a*, *a*, *a*, *a*, to a similar-shaped piece of ebony, which constitutes a portion of the frame, A A, of the instrument. To this piece of brass the parts which form my artificial horizon are fixed. C, shews the position of the horizon-glass; which I find convenient to place lower down than is usually done: the same alteration is also adopted with the sight-vane, D. E, represents a piece of brass which swings freely upon a small brass pin, *b*, and is secured there by the milled head, *c*; the piece E, has a projecting arm F, upon the end of which is fixed the small angular projecting piece, *d*, which I call the Director or Finder, the edge or line formed above *d*, at *e*, being one of the lines which I use to find the place of the true horizon. G, represents a piece of brass which fits into a square hole in the

stud-piece, *f*, where it may be held at any height by the thumb-screw, *g*. *h*, shews the position and shape of a small projecting stud, which has a gap filed in it, shewn by a dotted line near *h*: the line thus formed at the bottom of the gap is used as a guide to the eye of the observer to bring the finder or director to a proper place.

Fig. 2, shews a plan or bird's-eye view of the finder or director seen at E, fig. 1.

Fig. 3, represents a front elevation of the finder or director, with the same letters of reference upon the parts thereof that were used in fig. 1.

Fig. 4, shews a side view of fig. 2.

Fig. 5, shews a left-hand side view of the guide piece—shewn at G, in fig. 1. And

Fig. 6, shews a right-hand side view of the same piece—the form of the gap will in these two figures be very distinctly seen at *h*.

Fig. 7, is a plan or bird's-eye view of the same piece.

Fig. 8, shews a plan of the stud or arm, *f*, which holds the guide piece shewn at G, fig. 1.

Fig. 9, shews a plan of the brass pin, *b*, and milled head, *c*, upon which the director or finder, E, swings.

Having enumerated the various parts, and shewn the combination of that portion of my invention, which enables me to form an artificial horizon, I shall now endeavour, as briefly as possible, to explain the manner of adjusting and using the same with the greatest advantage.

When the Instrument with my Improvements is to be adjusted, it must be placed upon the three bearings seen at H, I, J, fig. 1; the last of which also forms a handle by which to hold the instrument when it is used; this is fixed upon a brass pin, about three inches long, by the screw, *i*. The surface upon which the quadrant is placed, must be varied in position, until the line formed above the angular piece at *e*, coincides with the real horizon. This being very accurately obtained, the instrument must be left at rest; and the brass guide piece, G, being placed properly in the hole

or recess provided for it in the stud, *f*, must be so adjusted for height, that a very minute line or portion of the part *d*, of the director, E, may be seen above the line, *h*, formed by the bottom of the gap in the guide piece, G. The line, *k*, drawn from the sight vane D, to the part *d* of the director, E, shews that it is a very minute height above the line formed at the bottom of the gap, *h*, in the guide piece G; and as the line *k*, cuts or passes through the horizon glass at *k*, it there shews the true place of the real horizon. When the instrument is to be used to take an observation at a time that the real horizon cannot be seen, it must be held in the left hand, by the handle, J; and the eye being placed at the sight vane, D, the quadrant must be moved in such a manner, that the line formed by the upper part, *e*, of the director, E, may be seen just above the line at the bottom of the gap, *h*, of the guide piece, G: and this, although artificially produced, will be the true place of the real horizon upon the horizon glass. The method of making the reflection of the sun coincide is the same as in other cases.

The directions here given imply that a coincidence is to be made as nearly as possible, by the two lines thus formed upon the two objects; the one being fixed, and the other being capable of moving upon its centre, until the due effect is produced. But should it be preferred, the coincidence may be formed with the lines on each side of the gap, *h*; in which case the guide, G, must be adjusted accordingly, so that a small portion of the part, *d*, of the director, E, may be seen forming a minute black line above each side of the gap, *h*.

Fig. 10. K, represents a front view of a brass case, the sides of which are made deep enough to cover the parts that form the artificial horizon; it is to be fixed to the brass plate, B, by four screws that pass through the ears, *o*, *o*, *o*, *o*.

Fig. 11, represents a front view of the upper part of the same case. The top and left-hand side are formed of plate glass, so that by this contrivance the whole of the parts

may be completely covered from the effect of high winds, and yet the parts necessary to be seen are quite visible.

Fig. 12, represents a side view of fig. 10, in order that the depth of the case may be more plainly understood. The dotted line shewn at *p*, *p*, *p*, *p*, in fig. 1, is the position upon which the case is screwed, the upper part is screwed to the projecting studs, *q*, *q*.

Fig. 13, represents the reverse side of a portion of fig. 1. A A, shews a part of the ebony frame, which has the brass arc, L, screwed to it by the screws *r*, *r*, *r*; the arc, L, is racked on its outer edge, to receive the teeth of the small pinion seen at *s*; the pinion, *s*, is fixed upon the back part of the index, M, by the brass cock, *t*, in which the pinion, *s*, turns, when it is fixed to the index; but in this figure the cock, *t*, is shewn only in dotted lines, that the position of the pinion may be more plainly seen.

Fig. 14, represents a front and side view of the cock, *t*, which may be fixed to the index by two screws that pass through the two small holes seen at the bottom of the front view. The hole in which the axis of the pinion works, is seen just above, in the same figure.

Fig. 15, represents a milled-head thumb screw, which is placed upon the square part of the axis of the pinion, *s*, and is retained there by the binding nut, *v*. The peculiar advantage that ensues from this construction and combination of the parts may be thus very shortly explained:—Whenever it is desired to move the index at large, by the hand, it may be done, as the pinion, *s*, is at liberty to turn freely upon its axis, and of course it will follow the motion of the index whichever way it is moved: and as the teeth of the pinion are constantly in gear with the teeth of the rack, it follows that the instant a minute adjustment is required, there is no previous preparation of clamping necessary; for the moment the finger and thumb are applied to the milled head, the minute adjustment is then under the most perfect command of the observer, and may be used with the greatest ease and precision. I shall here

observe, that as the radius of the arc that contains the divisions is much less in this quadrant than in those in common use, I therefore prefer having it divided into fourths of degrees, which will of course give half the number of divisions that are usually produced upon the common-sized arcs: hence it is necessary that the nonius should also be reduced from nineteen divisions to nine. But to this part of the instrument I lay no claim; as this method of dividing the arc is adopted, merely to accommodate the reduced size of the arc.

I shall here observe, that the small angular piece upon the upper part of the director, E, should be covered with black varnish; and the part of the guide, G, where the gap is made, should be either covered with any white substance, or it may be made of any white metal, by which means the contrast will be the greatest. And I hereby further declare, that I do not claim, as my invention, any of the parts that are common to and have been used in quadrants before.

My invention and improvements consist entirely:—

First, In substituting a rack and pinion in lieu of the tangent screw; by which means I am enabled to take an accurate observation with a quadrant having such an appendage, in less time, and consequently with greater certainty, than by any other means hitherto known or made use of.

Secondly, In constructing, combining, and applying certain parts herein set forth and explained, and which I call a Finder or Director, and also a part which I call a Guide, by the use of which, in the manner and way I have described, a more certain and effectual artificial horizon will be obtained; than was ever before known or made use of.

LXXV.—*On French Plating and Silvering**.

WITH A PLATE.

The first of these arts consists in firmly fixing thin leaves of silver upon the surfaces of metals; particularly upon

* From the *Dictionnaire Technologique*.

those of brass and copper. This art is very ancient, nor is it known when it was first invented.

Amongst the metals, it is principally upon brass and copper that the plater exercises his art, and very rarely indeed upon iron; yet, as the process is the same for all, we shall confine ourselves to describing the art of plating brass and copper.

The articles which are intended to be plated must be prepared by filing, turning, &c. in order that the surface on which the silver leaves are to be applied, may be perfectly smooth, and present no holes nor asperities. If the surfaces are enchased, all the outlines of the design should be so well finished, that neither the roughness from the casting, nor the marks of the hammer, can be perceived.

The various pieces being prepared as we have described, all the file-marks, &c. must be removed, by means of polishing-stones applied with water.

The pieces thus prepared are heated red-hot over a charcoal fire, and plunged into nitric acid, considerably diluted with water. In this they remain for a longer or shorter time, until they are completely freed from the scales or oxidation caused by heating them. Their surfaces are then rubbed over with pumice-stone and water, until they become quite bright.

They must then be heated again. But it is not necessary in this operation to make them red-hot;—it is sufficient, that, on being plunged into water, they cause it to bubble or hiss. They are then again plunged into weak acid. This occasions small asperities to be formed upon their surfaces, scarcely indeed apparent; yet, generally sufficient to retain the silver leaves which are to be fixed upon them.

These minute asperities are not, however, always capable of giving solidity to the plating; in which case it is needful to cover the surface of the pieces with hatchings; these are performed by means of steel knives, well tempered, and sufficiently hard. The form and size of these knives are proportioned to the different works upon which they are to

be used; and, consequently, the workman must have a proper assortment of them.

These hatchings can only be made upon plain surfaces, never upon enchased work; but the asperities of the latter are quite sufficient to retain the silver leaves.

The next operation is that of heating the pieces, whether of brass or copper, until they become of a blue colour.

As in this process they are obliged to heat the pieces frequently, and never allow them to cool until the plating is finished; in order to hold them, they are fixed on iron supports of various forms, according to the nature of the work to be plated, and of which, consequently, a great number is required.—We shall hereafter describe the form of one of the instruments which is most commonly used, and the manner of employing it.

The charging next follows.—This consists in applying the leaves of silver to the heated pieces, and fixing them by means of the burnisher.

The leaves of silver employed are about five inches square; forty-five of these leaves weigh one *gros*.

These leaves are spread one by one upon a cushion formed of leather stretched and nailed upon a board, and stuffed with horse-hair. The leaves of silver are cut with a knife to a proper size to fit the parts to which they are to be applied. During the progress of the work, the leaf of silver is taken up by means of small tongs held in the left hand, and placed on the heated brass or copper; and, with a steel burnisher held in the right hand, they strongly press and rub the leaf upon the piece. The friction is repeated, with the aid of heating the piece, until the leaf becomes fixed. It may be well to observe, that at the commencement, the workman applies two leaves at once to the heated piece.

It should be remembered, that several forms of burnishers are necessary, according to the work to be executed.—We shall hereafter describe the method of making and polishing these burnishers.

It sometimes happens, that in heating the piece, the fire

becoming too strong, blackens some part of it; in which case it must be *scratch-brushed*—that is to say, rubbed with a kind of brush made of brass-wire—to free the piece from the blackness formed upon its surface: which being done, they continue to apply more leaves, as before.

The plater always works upon two pieces at once, both in charging and burnishing. Whilst the one is heating, he operates upon the other. After he has applied two leaves of silver, he heats the piece to the same degree as at first; he then applies four other leaves of silver. These four leaves adhere to each other, and to those first laid on. To render this adhesion perfect, he passes a polishing burnisher over every part, strongly pressing upon and rubbing with it. This instrument differs from the former one, in having a longer handle.

The workman continues charging in this manner, laying on four or six leaves at once, until he has laid on every part from thirty to forty, fifty, or even sixty leaves, according to the degree of solidity and durability he wishes to give to his work.

When the number of leaves determined on are affixed to the piece, the workman finishes his labour of burnishing, with the polishing burnisher; which he performs with such care, that not the least joining can be perceived. To prevent this with greater certainty, he grasps the ferrule of the burnisher in his right hand, the handle being held in his left, and resting upon his arm: this position gives him more power, and allows him to use more skill in passing over every part of the work; and by repeating his strokes with the point of the burnisher, he finally gives it a beautiful brilliancy, and his work is finished.

The plating is considered as perfect, when the leaves of silver are equally spread over every part, and the burnishing so complete, that the eye cannot distinguish between a piece of plated work, and one made of solid silver;—On the contrary, the plating is bad, when it presents inequalities; when the silver does not perfectly adhere, and

the surface is rough, or the silver leaves employed are not of a good alloy.

When they would restore an old piece of work by replating it, it is necessary that the silver with which it is covered, should be previously removed. In order to do this, it is heated, and immediately plunged into weak nitric acid; it is then again heated and plunged afresh; and this operation is repeated until the whole of the silver shall have fallen off. This operation requires great caution, particularly when it is nearly finished; for they must be careful not to allow the acid to act too much upon the copper or brass; as it is apt to cause inequalities on the surface of the piece, which would considerably injure the beauty of the plating.

In the same manner the silver is removed from the surfaces of old plated work, before melting it. The silver is afterwards recovered in the manner of *parting*.

In order not to interrupt the description of these various manipulations, we have hitherto avoided giving any particular account of the instruments principally used by the plater;—it is therefore now necessary to enter into their detail.

We have before observed, that platers are obliged to heat the pieces they are at work upon, to a high temperature: they cannot therefore hold them in their hands, and are compelled to use instruments of considerable strength to support them, and resist the pressure made upon them with the burnishers. These supports, as we have already said, are made of iron, and are adapted to the various articles which are to be plated.

Were we to attempt a description of the numerous forms required, it would occupy too much time,—a peculiar support being necessary for every fresh article.

We must content ourselves, therefore, with describing one of the most important of these instruments, and which serves, in a great number of cases, as a support for the pieces to be plated; such, for instance, as plates, round or oval dishes, &c. It can be extended or contracted at plea-

ture; and for this reason the workmen term it *universal*, although it is evident that it cannot be used in every case.

A large flat ring, A A, Plate XII. fig. 1, of fifteen or eighteen inches in diameter, carries at four points, equally distant on its circumference, staples, B B B B, with parallel grooves within them, pointing towards the centre of the ring, and firmly riveted to it. Into each of these staples are fitted square pieces of iron, C C C C, with screws at their ends, which can be fixed at any point most convenient, by the screwed nut, D D D D. The upper parts of the squares C C C C, are bent at a right angle, and are pierced with several screw holes, E E, &c. into which the screws, F F, &c. with square heads fit, and can be turned by a key or wrench. These screws, F F, &c. serve to fix the pieces, G G, &c. which are to hold the article in the support. We can readily conceive that this instrument may be used for large and small articles, either with the squares fixed in the holes, in the manner shewn in the figure, or in any of the other holes; by sliding the squares in the staples; by changing the position of the pieces, G G, &c.; or, lastly, by reversing the squares themselves, so as to turn their points inwards.

The cushion on which the silver leaves are cut, is represented in fig. 2, at A B, the leaf spread upon it; C, the knife, the cutting edge of which (as is shewn) must be perfectly in a right line; D, the drawer which holds the books of silver, knife, &c.

Fig. 3, represents a burnisher. A, the long handle; B, the iron ferrule, which gives solidity to the end of the handle into which the stem of the burnisher is fixed; C, the burnisher. We must not lose sight of this remark, That as we press very strongly with the burnisher upon the pieces to be plated, too much attention cannot be given to fixing it firmly in the handle.

A good burnisher is not easily met with; therefore it is important to know how to form a perfect one. The good quality of a burnisher depends upon three requisites.

First, the steel of which it is made. Secondly, the temper given to it; and, lastly, the polish of its surface. We shall not speak particularly of its form, since it varies with that of the work to be burnished.

The best burnishers are made of *cast-steel*.—The required form, nearly, is given to it in the forging; and after leaving it to cool slowly, covered with ashes, to anneal or soften it, they carefully file it to shape; and finish, by smoothing it with a very fine file, so as to remove all the marks left by the coarser file, and in order to have less to do in polishing it, after being hardened.

They heat the burnisher in a charcoal fire, holding it by the stem, which does not require hardening; and when it has become of a *cherry-red* colour for the length of about two inches, it is quickly plunged into a vessel of cold water, stirring it about in order to renew the cooling surfaces. It will then have acquired a great degree of hardness, which it is necessary to diminish by tempering. In order to this, after having brightened its surface, by rubbing it with a dry pumice-stone, it is again heated in the charcoal fire till it acquires a *straw-colour*; it is then instantly plunged into oil or grease, to cool it suddenly, that it may preserve the requisite degree of hardness. It may then be mounted into its handle.

To polish the burnisher, especially near its end, which is the only part used, they make a longitudinal groove with a gouge, in a piece of hard wood, such as walnut or oak. This groove is made suitable to the form of the burnisher, and in it is placed emery mixed with oil. The burnisher is then rubbed about in every direction in this groove, until all the marks of the file are entirely obliterated. They commence by employing coarse emery, using finer in succession, and finish with very fine. When all the marks have been removed, so that they cannot be perceived even with a magnifying-glass, a fine polish is given to the surface.

The polishing is effected in the same manner as described

in the last operation. Instead of emery, however, they use the *purple* oxide of iron, which is known in commerce by the name of *le rouge d'Angleterre**.

We must be careful to change the wood, or at least the groove, every time the kind of emery is changed. This precaution must also be strictly observed in using the *rouge*; for without this, the necessary polish would never be obtained. The wood employed with *rouge* should always be softer than that used with emery.

The workman is obliged to re-polish his burnishers every now and then. This operation does not require so much time as at first, but is performed in the same manner†.

OF SILVERING BRASS.

One of the methods of silvering this metal, (and particularly the dial-plates of clocks, the graduated limbs of astronomical and philosophical instruments, &c.) is as follows:—

This process is termed *Silvering with the thumb*, because it is on this or the finger that the silvering is applied and rubbed upon the brass. The following process has been communicated to us by a celebrated silverer.

They take fine or cupelled silver, and reduce it, either by the flatting mill or with the hammer, to very thin laminæ. These are cut small, and thrown into nitric acid, contained in a vessel of glass or porcelain. When the silver is dissolved, they throw into the vessel twice as much water as the nitric acid employed.

They suspend in the middle of the solution a plate of copper well cleaned, and suffer it to remain a quarter of an hour;—the silver deposits itself upon it. When this plate is covered, it is removed, and another placed in its stead. The first is then thrown into a vessel of cold water:—the

* Or Crocus. For the preparation of this substance, see Vol. I. of this work, p. 432.—Editor.

† In this country, the polish of burnishers is generally renewed by rubbing them upon a piece of buffalo-leather, affixed to a flat surface, and supplied with putty, or the combined oxides of lead and tin.—Editor.

silver detaches itself from the copper, and falls to the bottom of the vessel. They repeat this operation, until they have recovered all the silver which the nitric acid held in solution.

When the silver is detached from the copper, it is washed in the water; and this washing is repeated in two or three other waters.

When the silver is well washed, they decant the water from it, leaving it nearly dry; it is then put into a glass mortar, and ground with a pestle of the same material.

To one *gros* of this silver powder they add two *gros* of cream of tartar (acid tartrate of potash), and as much very pure common salt (muriate of soda). They rub the whole well together, and add a few drops of pure water, so as to form the mass into a soft paste.

With a fine dry linen cloth wrapped round the finger, they take up a little of this paste, and rub it upon the surface of the brass, which had previously been well cleaned. They have at hand a vessel full of warm water, in which a little pearl-ash has been dissolved. In this warm water they wash the silvered brass. It is then laid in clean warm water, and finally in cold. The work is then wiped with a clean linen cloth, and its whitened surface exposed to a fire until it is perfectly dry.

With a little practice, this process succeeds perfectly; but we must wash the silvered article *immediately*; and no time must be lost in defending it from the action of the air, by a securing varnish.

ANOTHER PROCESS FOR SILVERING.

The Academy of Sciences have published a secret, which was communicated to them by a German named Mellawitz, for silvering brass, &c. readily, without employing silver leaves, as in the first method described in this Article. The Commission of the Society assure us that this process is very useful. We shall here describe it from the Memoirs of this learned Society.

They first moisten the surface of the metal to be silvered, which had been previously well polished and cleaned, with a hair pencil or brush dipped into water holding a little common salt in solution. They next gently and equally sift over the moistened surface some of the powder, the preparation of which we shall hereafter describe:—this adheres and forms a coat upon it. The piece, thus charged, is then placed in the midst of a well kindled charcoal fire, and continued there until it becomes red-hot.

It is then taken out with tongs, and plunged either into pure boiling water, or into water which holds a small quantity of common salt, or of cream of tartar, in solution; it is then *scratch-brushed*, to free its surface from the remains of the powder with which it had been charged.

This first operation is most essential; as the silver entering into fusion, penetrates the piece charged, forms one body with it, and prepares it for the succeeding operations. The metal penetrated by this first coat, appears already silvered.

They next proceed to cover the metal with a layer of paste, which they also spread equally over its surface with a hair pencil.

The piece is then heated to a *cherry-red*, withdrawn from the fire, and plunged for a short time into boiling water, and again *scratch-brushed* with cold water.

They continue thus operating until the piece has received four or five of these charges, when it will have become sufficiently silvered.

The work is finished either with chasing tools or with the burnisher, as required; and appears as brilliant, and as well polished, as if made of solid silver.

Composition of the Powder for the first Charge.

Having dissolved silver in nitric acid, precipitate this silver, by holding in the solution plates of copper, in the manner before described.

Take of this precipitated silver, well dried, one part;

Of muriate of silver, well washed and dried, one part;

Of purified borax (borate of soda) well calcined, two parts;—

Mix the whole in a glass mortar, triturating it well until it becomes a fine powder: pass this through a silken sieve.

Composition of the Paste for the succeeding Charges.

Take of the above-mentioned compound powder, one part;

Purified sal-ammoniac (muriate of ammonia), one part;

Pure muriate of soda, one part;

Sulphate of zinc, one part;

Pure sandiver, one part;—

Mix the whole carefully, and triturate it, first in a glass mortar, and afterwards on porphyry. Moisten the powder by degrees, with distilled water, or weak gum-water, until it forms a kind of paste, which may be taken up, and spread with the pencil.

Pieces silvered by this process have been broken, and it has been found that the silver, &c. had penetrated the copper; so that this method of silvering is very durable. Whereas in the silvering with leaves, if any part is worn off, the whole must be removed, and silvered afresh.

The wear of the pieces silvered by the last-described process, on the contrary, is easily and quickly repaired: it is sufficient to repeat the charge on the injured parts only.

If it does not require more time to charge the piece entirely, by exposing it again to the action of heat, as before described, it will appear as beautiful as ever.

If the silvered pieces have been tarnished by any vapours, (even by those of sulphuretted hydrogen,) a new charge will restore it to its primitive beauty.

Finally, this new method of silvering may be employed on the thinnest pieces of metal designed for ornaments, which is very difficult with the silvering in leaves, especially if the plates are embossed. The Academy of Sciences have proved the truth of all these facts.

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LXXVI.—*On Artificial Plumbago; on Hardening Black Lead; and on Hardening Charcoal.* By J. MacCulloch, M.D. & F.R.S.—*With Remarks by the* Editor.

In a Paper in the last Edinburgh Philosophical Journal, "*On Black Lead from Cast-Iron*," from which we have made the following extracts;—Dr. MacCulloch states, that he found black lead more than twenty years since, on examining the metal of cast-iron guns and shells by solution in acids; and also, that in 1807 or 1808 he was requested to go to a London porter brewery to see an appearance which had very much surprised the people employed in it, namely, that of iron taken out of their porter backs in making some repairs, which they had found, as they said, red hot. On closer examination, however, the red heat was found to be an exaggeration. But, on removing the iron articles in question from the porter, they became so hot, on scraping off the surface, that it was disagreeable to handle them. These pieces of iron were cast cones, perforated with holes, and about an inch thick, and had been used as strainers to prevent foreign substances from getting into their pipes. They had been immersed in the porter many years, and although they appeared entire, yet some of them were quite converted into black lead.

He also states, that, in one of his journeys into the Western Islands, he learned that in the year 1740, some iron guns were brought up from the wreck of the Florida, one of the vessels of the Spanish Armada, by means of a diving-bell; that they were very deeply corroded; and on scraping them, it was said that they were found so hot that they could not be touched, and that they did not become cool till they had been two or three hours exposed to the air.

The following is the result of the experiments he made upon this subject.—The blackest pig-metal appears to

yield the greatest quantity of black lead, and in the most solid state. When the experiment is complete, the produce equals the iron in bulk, and is a solid mass, capable of being cut by the knife even into pencils.

To procure it in perfection, the acid should be very weak. Acetous acid appears to be best; and it is by this that it is produced in porter backs, in the waste-pipes of breweries, and in calico-printing-houses, where sour paste is employed. Very dilute mineral acids also succeed; but, with these, one of the results is sometimes not obtained.

If the experiment is perfect, the black lead becomes hot on exposure to air, smoking while there is any moisture to be evaporated, particularly when the surfaces are scraped off in succession, so as to give access to the air.

This artificial black lead can never, however, be freed from the brown colour which it gives to paper, arising from some rust which it retains.

He also says, that if soft black lead, which yields a black as well as soft streak, be heated without burning, it diminishes in bulk and increases in specific gravity, while it becomes hard and gives a pale streak. This is the process used in making hard and pale pencils; and it appears to consist in the loss of a portion of oxygen, or in the reduction of the black lead to a state somewhat nearer to that of metallic plumbago. Thus, in drawing, artists harden the points of their soft pencils in the flame of a candle.

Something very similar happens in charcoal. After giving out hydrogen it becomes harder and more brilliant, so as, from scratching the softer metals, *to become capable of corroding glass*. In this state it loses one of its valuable qualities, so as to be no longer fit for making gunpowder. Naturally, some woods produce hard charcoal, and others a soft kind; and the latter alone are fit for this purpose. But the softest may be injured by overheating, or they can be reduced to this hard state; so that the wood of the willow or alder may become as bad as that of the oak. This is an accident far more likely to happen in the me-

thod of charring in retorts, than in the common way of making charcoal in pits; although that process is always used in the gunpowder manufactories. It is for the same reason that animal charcoal, or that of coal, will not make gunpowder. Both of these are hard and brilliant; and the former, in particular, has sometimes a pseudo-metallic lustre, equal to that of black lead. The chain of analogy is thus extended among all these substances.

REMARKS BY THE EDITOR.

We have made the above extracts from this valuable paper (to which we particularly recommend the attention of our readers), with a view to making the following additional remarks.

And, First, to mention another source of obtaining artificial black lead. That experienced metallurgist, the late Mr. W. E. Sheffield, in order to precipitate copper from its solution in acids, in his Assays of Ores, preferred the employment of plates of cast-steel, of about an eighth of an inch in thickness, two inches broad, and long enough to reach to the bottom of his conical vessels. These, in a little time, became entirely converted into black lead, so soft as to be readily cut with a knife, and capable of making black streaks upon paper; but, unfortunately, tinged by the rust of the iron.

Secondly, to suggest to the makers of charcoal in retorts, that the willow charcoal, which has, by overheating, become *too hard* for the gunpowder-maker, will, from that very circumstance, have acquired additional value for many other purposes; and particularly for cutting and polishing decarbonated cast-steel: and not only so, but it is likewise much superior for polishing Brass and Copper-plates, and for the Engraver's purposes, than the ordinary willow charcoal; and ought, therefore, to be reserved for these uses.

Lastly, We would point out the improvement of the ordinary willow charcoal, by re-burning it in closed cast-iron vessels, in order to give it a greater degree of hardness.

LXXVII.—*On the Fabrication of Artificial Pastes in Imitation of Precious Stones.* By M. Doualt Wieland*.

A Prize having been offered by the Society for the Encouragement of the Arts in France for the best memoir on the subject, it was decreed to M. D. Wieland.

The base of all these imitations is strass, or white crystal. The materials employed are melted in Hessian crucibles, and a porcelain furnace, or, which is preferable, a potter's furnace is afterwards used. The more tranquil and prolonged the fusion is, the more hardness and beauty does the strass acquire.

Strass.—The following three mixtures give a very fine strass:

Rock Crystal, . . .	0,318	0,3170	0,300
Minium, . . .	0,490	0,4855	0,565
Potash, pure, . . .	0,170	0,1770	0,105
Borax, . . .	0,021	0,0200	0,030
Arsenic, oxide of, . . .	0,001	0,0005	
	1,000	1,0000	1,000

M. Lançon recommends the following mixture for a pure strass:

Litharge, ...	0,540
White Lead, ...	0,406
White Tartar, or Potash, . .	0,054
	1,000

Topaz.—The imitation of topaz is difficult. It passes from the white of strass to sulphur yellow, violet, and red purple, according to circumstances which are not

* From the *Bulletin de la Societe d'Encouragement*, Tom. XVIII. p. 311. We acknowledge ourselves indebted to the *Edinburgh Philosophical Journal*, No. xiv. for the Translation of this valuable Article.—Editor.

determined. The following are two of M. Wieland's recipes:

White Strass, . . .	0,95816	0,99
Glass of Antimony, .	0,04089	
Purple of Cassius, . .	0,00095	
Oxide of Iron, ...		0,01
	1,00000	1,00

These mixtures sometimes yield an opaque mass, translucent at the edges, and of a red colour, in thin plates. By mixing it with eight times its weight of strass, and keeping the mixture in fusion for thirty hours in a potter's furnace, the result is a fine yellowish crystal. This crystal remelted by the blow-pipe, produces the finest imitation of the eastern *ruby*.

Ruby.—A ruby less beautiful, and of a different tint, may be made thus:

Strass, ...	0,9755
Oxide of Manganese, . . .	0,0245
. . . . .	1,0000

Emerald.—This paste is very easily made; and that which approaches the nearest to the mineral is the following:

Strass, ...	0,98743
Green Oxide of Copper, . . .	0,01200
Oxide of Chrome, ...	0,00057
	1,00000

The following is M. Lançon's recipe for Emerald:

Strass, ...	0,9905
Acetate of Copper, ...	0,0080
Peroxide of Iron, ...	0,0015
	1,0000

Peridot.—By augmenting the proportion of oxide of chrome and oxide of copper in the first composition of

emerald, and adding oxide of iron, we may vary the green shades, and imitate the peridot and deep-coloured emerald.

Sapphire.—The composition for this paste is,

Strass, very white, ...	0,9855
Oxide of Cobalt, very pure, .	0,0145
	1,0000

This mixture must be put into a Hessian crucible, carefully luted, and remain thirty hours in the fire. If the process is well conducted, the result will be a very hard glass, without bubbles.

Amethyst.—Very deep amethyst may be obtained with

Strass, ...	0,9870
Oxide of Manganese, . . .	0,0078
Oxide of Cobalt, ...	0,0050
Purple of Cassius, ...	0,0002
	1,0000

M. Lançon uses,

Strass, ...	0,9977
Oxide of Manganese, . . .	0,0022
Oxide of Cobalt, ...	0,0001
	1,0000

Beryl, or *Aquamarine*, is made with

Strass, ...	0,9926
Glass of Antimony, ...	0,0070
Oxide of Cobalt, ...	0,0004
	1,0000

Syrian Garnet.—This paste is used for small jewels, and is made with

Strass, ...	0,6630
Glass of Antimony, . . .	0,3320
Purple of Cassius, ...	0,0025
Oxide of Manganese, . . .	0,0025
	1,0000

In the fabrication of these pastes, many precautions are necessary, which can be learned only by experience. The materials should in general be carefully pulverized. The mixtures should be properly sifted, and the same sieve should not be used for different compositions. In order to obtain the glass well melted and homogeneous, and without striæ and bubbles, materials of great purity must be employed; the best crucibles must be used; the fire must be regulated, and kept equal to the maximum temperature; and the mass must be left in the fire from twenty-four to thirty hours, and allowed to cool very slowly.

LXXVIII.—*On the Uses of Sulphate of Lead in the Arts.*—By M. BERTHIER*.

THOSE dyers and calico-printers who prepare their aluminous mordant by decomposing alum by acetate of lead, obtain at the same time a large quantity of sulphate of lead. M. Berthier, in a paper published in the *Annales de Chimie et Physique*, has detailed the various uses which may be made of this product. In the first place, it may be heated to redness with a sufficient quantity of charcoal powder; half the sulphuric acid which it contains is converted into sulphurous acid, and the sulphur belonging to the other half forms a *subsulphuret* with the lead. The sulphurous acid carries with it a portion of the subsulphuret in the state of vapour. When the heat is carried beyond redness, the subsulphuret is decomposed, and changed into another sulphuret, which is volatilized, and into lead, which remains mixed with the undecomposed subsulphuret. The higher the temperature, the greater the loss of lead by volatilization.

* From the *Annales de Chimie et Physique*, Tom. XX. p. 275.—We are indebted to the Quarterly Journal of Science, &c. No. xxvii. for the Translation of this valuable addition to our Article "On the Acetate of Alumine," p. 274.—EDITOR.

100 grains of sulphate of lead, mixed with 9 grains of charcoal, and heated in a retort, gave out sulphurous acid gas for half an hour; a scoriform mass of subsulphuret of lead remained, and carbonic acid and oxide were also evolved.

10 grains of sulphate of lead, heated for half an hour in a coated crucible in a calcining furnace, yielded a metallic scoria weighing 7.1gr. It consisted of 0.4 sulphur, and 6.7 lead. Sulphate of lead only contains 0.683 of metal, —so that very little was volatilized.

These, and similar experiments, shew that, by uniting sulphate of lead with about one-tenth its weight of charcoal, it is converted into subsulphuret without material loss of weight. This subsulphuret may be treated as galena, and the lead easily extracted. But there is a simple and more economical means of reducing sulphate of lead. Sulphate and sulphuret of lead may be made mutually to decompose each other; and if mixed in proper proportions, pure lead is the result. Pure lead may also be obtained from a mixture of sulphate and subsulphuret of lead, as the following experiment proves. 20 grains of sulphate, mixed with 29 grains of subsulphuret, were heated to whiteness in an earthen retort: pure sulphurous acid was evolved, and a button of ductile metallic lead, weighing 38 grs., was obtained, covered with a thin crust of vitrified oxide. As the original mixture only contained 40 grains of lead, it will be observed that the entire loss of metal in the above reduction amounted to five per cent. only. If sulphate of lead be heated with such proportion of charcoal as is insufficient to reduce it entirely to sulphuret, that portion of sulphuret which is formed will re-act upon the undecomposed sulphate; and if the proportions be so arranged, that the sulphuret and sulphate are to each other as 29 to 20, the product of the operation ought to be pure lead. This is the case when sulphate of lead is heated with 0.06 its weight of charcoal.

Secondly, Sulphate of lead may be converted into oxide,

by heating it to whiteness with 0.03, its weight of charcoal. The oxide which I thus obtained was compact, vitreous, transparent, and of a fine resin-yellow colour. We see, then, that by the aid of charcoal only, we may convert sulphate of lead into subsulphuret; into pure lead, and into pure oxide. We may also decompose sulphate of lead by metallic lead: for this purpose the proportion of metal should be 0.68 that of the sulphate. With these proportions I obtained a very pure oxide. One may also convert sulphate into oxide of lead, by heating it with subsulphuret in the proportion of 7.3 parts of the latter to 10 of the sulphate.

Thirdly, Sulphurous acid may be obtained from sulphate of lead: but as this acid could only be used for the production of sulphuric acid, and therefore only as a substitute for sulphur, it is useless to enter into the details of this decomposition.

Fourthly, In the lead furnaces, sulphate of lead and galena may be conveniently reduced together. 79 parts of galena, and 100 of the sulphate, treated as usual in the reverberatory furnace, afford about 137 parts of metallic lead.

Fifthly, Sulphate of lead may be decomposed by silica. 11 grains of sulphate of lead were mixed with 16 of finely powdered rock crystal; this mixture was ignited for an hour in a small Hessian crucible;—the loss of weight sustained in this operation amounted to 3.3 grains, which is little more than the weight of the sulphuric acid contained in the sulphate. A white, spongy, and translucent enamel was thus obtained. 4 parts of quartz and 12 of sulphate, and 4 of quartz and 6 of sulphate, afforded compact and transparent yellow glasses; and the sulphate was in all cases decomposed.

Sixthly, Sulphate of lead may be used for glazing pottery, and it may be substituted for minium in the manufacture of glass and pastes.

Lastly, Sulphate of lead may be decomposed by carbo-

nate of ammonia or carbonate of potassa, for the production of *white lead.* The former operation can only be economically practised by the manufacturers of sal ammoniac, and it is doubtful whether the latter would afford a ceruse equally fit for the painter's use with that obtained by other and cheaper methods.

LXXIX.—*On the Cultivation of the Ranunculus and Anemone, By the Rev.* WILLIAM WILLIAMSON, *Corresponding Member of the London Horticultural Society. In a Letter to the Secretary**.

DEAR SIR,

I FIND great pleasure in complying with your request, that I would send you an account of the method which I have practised for some years of cultivating the *Ranunculus* and *Anemone*; and hope that some of the observations may prove useful to those Members of the Society who may be desirous of growing these beautiful productions of nature. I may premise that the culture of these two sorts of flowers is so much the same, that it seemed superfluous to make them the subjects of different papers. It is, however, necessary to state, that the following observations are strictly applicable to the Ranunculus only, though the general detail may be considered as equally suitable to both.

In order to grow these flowers both numerously and of a large size, florists usually employ a very rich soil; but in making the soil so very rich, it is in general rendered so light as wholly to destroy the effect intended to be produced. I am acquainted with several persons who are in the constant habit of cultivating these plants, and they all agree that they cannot with certainty exhibit a fine bloom from the same roots during successive years—the cause of which, I conceive, may be thus explained. In perennial

* From Vol. IV. of the Society's Transactions, for 1822.

fibrous-rooted plants, the strength of the blossom depends upon the impulse that is given to the plants in the season in which they flower; but not so in bulbous roots: their strength depends upon the quantity of sap that is laid up in the roots by means of their foliage during the preceding year. Now it is generally supposed that the roots of the Anemone and Ranunculus are very impatient of frost; and they are, in consequence, planted so late in the spring, that there is not sufficient *moisture* (which is so very essential in the early stages of their growth), nor even *time* for the roots to throw out such a sufficiency of leaves as to insure the future strength to the roots, before the north-east winds set in, which in this country, at least of late years, have generally prevailed during the month of March, and sometimes much later: these winds, which dry the soil very rapidly, must be prejudicial in proportion to the lightness of the compost; and when roots are stunted in the earlier stages of their growth, the bloom of the present year has but little beauty; no skill can possibly make them exhibit a fine bloom in the succeeding season, and frequently two or three years must elapse before sufficient strength is given them to cause them to blow in perfection.

I therefore conceive that these roots require not only a rich but a compact soil; and were I to recommend any compost to be made for them, it would be a stiff loamy clay, enriched by the addition of at least one-fourth part of good rotten dung: but if the soil of the garden be of a loamy quality, no manure is necessary. I find that of my own garden to be so congenial to them, that I never yet failed to exhibit a fine bloom;—it is a rich hazel loam of about two feet in depth, having a brick earth for the subsoil. The ground is roughly dug in October, but not deep; so that the lower part of the soil is not moved at all: the fibres of the roots, when planted, soon penetrate this compact soil, and draw moisture from it, and consequently flourish, whatever may be the state of the upper part of the bed. I frequently plant the roots in the same

place for several years successively: the soil then, of course, requires manure, and should be dug deeper, but as early as possible, that it may become close and firm before the roots are planted, and also that the manure may be more perfectly blended with the mould.

It has been remarked, that we seldom have a second frost of much intensity or duration. It has therefore been my usual practice to plant the roots immediately after the first severe frost; at all events, I never delay the planting after the 10th of February. Before the leaves appear, I usually move the surface of the ground, if practicable, with a Dutch hoe; both to destroy the weeds, and also to make the surface light and porous; for it is found by experience that those plants flourish best, when the upper part of the soil is continually moved; and after they do appear, a small hand hoe applied between the rows is found extremely beneficial.

The injury which the roots of the Ranunculus and Anemone are liable to sustain by frost, is not, I conceive, very great. I have proved, by several experiments, that they will bear a great degree of cold, provided the soil is not naturally wet. The whole of mine, amounting to many thousands, were last spring unexpectedly exposed to a severe frost, the thermometer standing at 11° below the freezing point, and I am not aware that any of them perished. It should however be mentioned, that it was a hoar-frost, which is not so prejudicial to many plants as what is termed a black frost, though its absolute severity may be much greater. A great majority of these roots were seedlings, which I find are more able to endure hard weather than our older varieties; they were totally unprotected, and many rows were planted so near the surface, that their crowns were distinctly visible. When the roots decay, it is not in general during the winter, but late in the spring, after the vernal rains; it therefore seems extremely probable that were they protected in the winter and spring during heavy and continued rains, by a covering of sail-

cloth raised to some distance from the ground, they might be exposed to the severity of frost without fear of losing them. This is, however, only a conjecture, but it merits a trial; for if they are planted before the winter, and survive it, they not only bloom earlier and finer, but the roots are more increased both in number and size.

As to the proper time of taking up the roots, I am again constrained to dissent from general opinion. I consider that we usually suffer them to remain too long in the ground after the bloom is over. If the sap of the present year is to afford nourishment for the foliage and bloom of the next, we ought to accumulate the sap as much as possible in the root: now the fibres of the root must begin to decay before the foliage changes at all, for one is the consequence of the other; reason therefore seems to point out to us the propriety of taking up the roots immediately that the foliage begins to change, that the sap which is contained in the leaves may remain in the root, and not pass into the earth through the fibres that are still attached to it. For the sake of neatness, I have usually washed the roots after they are taken up, though it is a matter of no real utility; they should at first be placed upon the floor of an airy room, where they may dry gradually, and be then separated, and securely laid by, ready for planting in the following season.

The increase of these plants is effected by three different methods:—by seed, by offsets, and by cutting the roots.

The only method by which new varieties can be obtained is from seed. It is well known that the seed which is procured from those flowers which are already partly double, is more likely to produce either double or semi-double flowers than the seed from single ones. The first object is, therefore, to procure roots which produce *semi-double* flowers; for were they quite double, no seeds could be had from them, the stamina being entirely destroyed by the impletion. I have heard many persons complain of the

difficulty they experience in making the seed vegetate: this arises from bad management; and if the following directions be attended to, I am convinced success will be certain. In the first place the seeds must be *sown early*, for moisture is essential to their vegetation: and as they frequently remain six weeks or two months in the ground before they come up, it is absolutely necessary to sow early in the year, to secure a certainty and continuance of moisture. I have sown the seed from the beginning of September to the end of January, with various success; if the winter be mild, the autumnal sowing is much to be preferred. My practice now is to sow half my seed in the autumn, it then appears in the beginning of November; and the other half as early in the month of January as the weather will allow: the first sowing will succeed, should the weather prove mild; but that of January is almost certain to do well, though the roots will be much smaller than those raised from the autumnal sowing*. Another point to be attended to is, not to sow the seeds *too* deep; the least covering will be sufficient. I need scarcely mention the necessity of a frequent and careful weeding by hand, during the time the plants are growing. When the foliage decays, which will be early in June, the ground ought to be entirely pared to a sufficient depth, and afterwards sifted, that all the roots may be certainly saved; for the smallest most frequently produce the best flowers. By these methods I have often raised many thousands in one year; and by continual selection of the best seed, I now have them in such perfection, that out of many thousand new seedling roots, which I bloomed last year, I had only one absolutely single one, that is with five petals; but I had many full double flowers of great beauty.

* March 18, 1821.—I sowed a large bed, containing several perches, on the 23d September last, the seed vegetated in the latter part of October, and the young plants continued in a growing state till they were entirely cut off by the frost in the latter part of the year: the other half I sowed as soon as the weather permitted in January last; they are now just appearing, and likely to do well.

The semi-double flowers I continue to bloom for several years, as I find that I cannot appreciate their real qualities under two or three years; for though they are only semi-double when they first blow, they may afterwards become double by a skilful cultivation. These flowers become double in two ways: first, by the multiplication of their petals; such are obtained at once from seed, and seldom or ever vary from what they were originally; secondly, by the conversion of the stamina into petals; this is effected entirely by skilful culture, and such are generally the fullest and most beautiful flowers; as the colours of the petals thus formed will always be the same as the stamina, which are frequently of a different colour from the proper petals. Those beautiful Anemones with rows of petals of different colours, which have lately been imported from Holland, have been produced in this manner; they are however liable to return to their original state, without great skill and attention.

The method of increase by offsets is well known, and is chiefly resorted to in perpetuating varieties of known excellence.

There is another way of increasing these plants, which is not so generally known; that is, by cutting the root into parts. This is chiefly used to preserve any particular variety raised from seed, and of which only that root is in existence. In minutely examining the crown of a Ranunculus, several small protuberances will be found, from each of which a shoot will arise; and the root may therefore be divided by a sharp knife into as many parts as there are protuberances, and thus the danger of losing the variety is much diminished. These cuttings will not shew any blossom in the first year; but a perfect root will be obtained from every cutting, and these will blow in the following year.

I will only now add an account of my endeavours to obtain double-flowering roots of the Anemone, and some

experiments made to ascertain the best time of planting the roots.

Being fully convinced that new double varieties of the Anemone might be successfully raised in this country, I endeavoured to procure some semi-double flowering roots; but being unable to get them, I was under the necessity of raising them myself. I therefore, year after year, sowed the seed of the *Anemone coronaria*, but it was several years before I observed the least disposition in the seedlings to multiply their petals: I however persevered in sowing the seed, and at last raised a few that had one petal more than the usual number; the seeds of those I saved and sowed, and by perseverance in the same course, have now several varieties that have six or seven distinct rows of petals; and I am confident that by continued selection, I shall be able to produce double and semi-double flowers of the Anemone, with the same facility as I do of the Ranunculus.

In the autumn of 1818, I divided nine ounces and a half of double Anemones into two equal parts, equal in weight and number of roots; each part weighed four ounces and three quarters, and contained one hundred and twenty roots. The first half was planted October 10th, 1818, and when taken up they weighed thirteen ounces. The other half was planted February 10th, 1819, contiguous to the others, and when taken up they weighed only five ounces and a half, making a difference of seven ounces and a half in favour of those planted in the autumn, the flowers of which were also larger and more numerous. The extreme mildness of the winter was, no doubt, favourable to the autumnal planting. On the 28th January, 1820, I again planted the whole of the eighteen ounces and a half, but found, when they were taken up this summer, that they weighed only ten ounces. I therefore conclude, that—subject to the risk of damage by severe frost, which I conceive not to be great,—the autumnal planting is preferable, provided that the sub-soil be not too retentive of moisture;

in that case they would inevitably perish. This opinion is also strengthened by the following experiment. In the summer of 1819 I took up a bed of Anemone roots; but found in the autumn that a considerable number were left in the ground: early in October these were transplanted; whilst the others, which had been taken up in the summer, were planted a few days before Christmas. The transplanted roots survived, while the whole of the others perished.

I am, Dear Sir,
Your obedient humble Servant,
WILLIAM WILLIAMSON.

Westbere, near Canterbury,
9th November, 1820.

POSTSCRIPT.

March 18, 1821.—My Ranunculus roots were last winter again exposed to a severe frost, the thermometer standing at 10½° below the freezing point; and as they were in a much more forward state than usual, owing to their being planted earlier, I was apprehensive lest they might be injured; but upon a careful examination, I cannot find that they have received any damage whatever.

LXXX.—*On the Use of the Blow-Pipe in Chemical Analysis, and in the Examination of Minerals.—By* J. J. BERZELIUS. *Translated from the French of* M. FRESNEL, *by* J. G. CHILDREN.

[Continued from p. 245.]

"CUTTING PLIERS, made thick and strong in the cutting part, are useful for detaching small portions from a specimen without injuring it.

"*A pair of pliers*, terminating at one end in a point, are useful in trimming the lamp.

"*Hammers.*—Two of hardened steel are necessary. The face of one should be round and polished; it is used to flatten the grains of reduced metal: its other end must

have the form of a narrow cone, with an obtuse summit, and serves to detach portions of the mineral to be examined, when it is required to confine the blow to a small part of the surface. The face of the other hammer should be square, and its edges sharp; its opposite end is formed like, and serves the purpose of, a chisel. This hammer is useful for chipping off small portions from a specimen, for examination. All its edges should be kept sharp.

"*Anvil.*—A parallelopipedon of steel of about three inches long, one inch thick, three-quarters of an inch wide, and polished on all its faces, is most convenient for this purpose. It is used to crush pieces of minerals, which are to be wrapped in paper and laid on the anvil, and struck with the hammer. The paper prevents the dispersion of the fragments. When we would try the malleability of a grain of reduced metal, it is to be treated in the same manner.

"*Knife.*—A knife of hard steel, of the size of a penknife, with a sharp but not too fine edge and point, is useful for trying the hardness of bodies, which is estimated by the greater or lesser resistance they oppose to it. Its point also, previously moistened by the mouth, serves to take up portions of the fluxes, and, if necessary, to knead them with the pulverized mineral in the palm of the left hand. In short, the knife is one of the most indispensable instruments used with the blow-pipe.

"*Files.*—A triangular, a flat, and a round, or half-round file are useful.

"*A small agate pestle and mortar*, the smaller the better. That which I use is scarcely two inches in diameter, and half an inch high on the outside. Its cavity is five-sixteenths of an inch less in breadth and depth*.

"It is desirable that the bottom of the mortar be some-

* "Gahn having once lost the pestle of a similar mortar, took a button of calcedony of suitable diameter, and fixed it with sealing-wax to a cork. This new pestle was the only one he ever used afterwards. I have been obliged to have recourse to the same expedient, and have thought it right to mention it in this place, for the use of those who may fall into a similar predicament.—B."

what transparent: but it should be quite free from cracks and crevices, in which the pulverized substances would lodge.

"A small piece of pumice-stone should be kept at hand, to remove the traces sometimes left on the surface of the mortar by metalliferous substances.

"*A microscope*, with one or two plano-convex lenses of different powers, which form Dr. Wollaston has shewn to be best adapted to enlarge the field of distinct vision. In the sort of experiments we are treating of, the microscope is often indispensable to ascertain the result; and we must be cautious how we decide as to colour, before we have examined the object by its means; for the light reflected by the charcoal on small globules of glass often produces false appearances, which the microscope corrects.

"*A box with compartments*, to hold the fluxes; and a tray of sheet iron not tinned, lined with white paper, to catch the particles which fall from the support during an experiment—are useful.

"*A glass tube*, with a fine orifice, passing through a cork fitted to the neck of a phial half-full of water, is convenient for washing the charcoal powder from the grains of reduced metal, in certain experiments*.

"*A polished blood-stone* is useful to rub the metallic substances on, that have been reduced but not fused, in order to ascertain if they be possessed of metallic brilliancy, &c.

"*Small porcelain capsules*† are useful to hold the fragments that have been, or are to be, examined, &c.

* "This is a neat contrivance of Dr. Wollaston's for dropping water. Berzelius calls it the "*Fountain of compression*," and describes the mode of using it thus: "The cork is fixed in the neck of a flask half-full of water, which is turned upside down, and into which *we blow, so as to compress the air within*. This air, by afterwards dilating, produces a fountain." The dilatation of the air by the heat of the hand, is however, in general, all the expansive power necessary to expel the water. It is convenient to have the tube bent nearly at a right angle, about an inch from the orifice. C."

† "Or watch-glasses.—C."

"Order in the arrangement of the various instruments is very essential, so that the operator may in a moment lay his hand on whatever he may want*.

"The following apparatus is not particularly connected with the uses of the blow-pipe, but is convenient. Plate X. fig. 11, is a small vice, having a hole at *m*, for sliding on an upright brass rod, furnished with a foot (not shewn in the plate), to which it is fixed by the screw, *k*; the opening in the vice receives the triangle, *a*, *b*, *c*, fig. 12, and is tightened by the other screw, *l*. At *d*, is a joint, to fold the triangle together for the convenience of travelling, &c.; *e*, *f*, *g*, *h*, on the side, *a*, *c*, are small holes, each intended to receive one end of a steel wire, bent at each end into a right angle, the other end fitting into a corresponding hole on the side, *b*, *c*. The large triangle, *a*, *b*, *c*, may thus be divided into four smaller ones, according to the diameter of the capsule, crucible, &c. intended to be supported by it. The triangle is made of strong iron plate, and the length of its side is about two inches and a quarter.

"*A magnetic needle, and Haüy's electrical needle*, and also a *small bar-magnet*, for rendering very weak magnetic attractions perceptible, (after the manner pointed out by M. Haüy,) are necessary.

"To these articles may be added a pair of small scissars, a pair of small tongs to hold crucibles, &c. when heated by the spirit-lamp; a touchstone, and some assay needles, made of alloys of gold of different standards, for trying the purity of gold."

[*To be continued.*]

* "Here follows a long detailed description of a table, with a drawer on each side, and four in front, divided into moveable compartments of tinned-iron, to hold the various instruments, &c. not forgetting a hook with a towel fixed to the right leg of the table. Next comes a description of a red morrocco case, to hold a travelling blow-pipe apparatus. These things are all very useful, but I cannot agree with our author, that a particular description of them is necessary. I have, therefore, omitted them.—C."

LXXXI.—*Observations on the Cultivation of Strawberries; with Remarks on the rapid Formation of their Blossoms and Fruit. By the Reverend* THOMAS GARNIER, *Member of the London Horticultural Society. In a Letter to the Secretary*.*

MY DEAR SIR,

WHEN I had the pleasure of seeing you here a few days ago, you expressed a wish that I would lay before the Horticultural Society a detailed account of the method which I have practised for some years of *cultivating the different varieties of the Strawberry*. It affords me great satisfaction to comply with your request, particularly as considerable quantities of my strawberries have been exhibited at various meetings of the Society, in the course of the two last summers, and which were generally allowed by the Members present to have attained no ordinary degree of excellence, both in respect to size and quality.

The observations I am about to submit to the consideration of the Society, are the result of my own experience, and may perhaps afford some useful hints to the cultivators of this much-esteemed fruit.

The piece of ground I have appropriated for the production of strawberries, is well exposed to the sun and air; but at the same time is very much sheltered from the violence of bleak and cutting winds. The soil consists of a dark sandy loam of about two feet in depth, having a very fine white sand for the sub-soil, which I take care never to disturb. In preparing the ground for my crops, I trench it all over two spades deep, and then lay upon the surface a dressing, about two inches thick, of rich yellow loam, rotten dung, and bog earth, mixed together in equal proportions, and which is afterwards well dug in with a fork. I then form the beds four feet four inches wide, with alleys at least two feet wide between them. The runners of most

* From Vol. IV. of the Society's Transactions, for 1822.

varieties are set out eighteen inches from plant to plant, and the same distance from row to row; the Roseberry and common scarlet do not require so much room; I consequently set them sixteen inches from plant to plant, and only allow a foot between the rows, which I find quite sufficient for their growth. The sorts I prefer and cultivate chiefly, are the pine, Downton, Mathven-Castle, hautboy, Hudson's Bay, Wilmot's late scarlet, common scarlet, Keen's imperial, and two sorts of Chili; but I never suffer any of the varieties to remain in the ground more than one year. Early in August, or as soon as the gatherings are over, I destroy all my beds, and proceed immediately to trench, form, and manure them in the manner before directed, to receive the plants for the crop of the succeeding year, taking care to select for that purpose the strongest and best-rooted runners from the old rejected plants. If at this season the weather should be particularly hot, and the surface of the ground much parched, I defer the operation of preparing my beds and planting them, till the ground is moistened by rain.

Such is the simple mode of treatment which I have adopted for three successive years; and I have invariably obtained upon the same spot a great produce of beautiful fruit, superior to every other garden in the neighbourhood.

Depth of soil I have found absolutely necessary for the growth and production of fine strawberries; and where this is not to be obtained, it is useless, in my opinion, to plant many of the best varieties.

It is not generally known, (but I have ascertained the fact,) that most strawberries generate roots, and strike them into the ground nearly two feet deep, in the course of one season. The pine and Roseberry succeed better than any other in stiff and shallow soils; but they should always be planted in an open situation, and not, as is too commonly the practice, in shady and neglected parts of the garden.

Before I close this communication, it may not be unin-

teresting to subjoin a few remarks on the extraordinary *quick formation of the blossoms and fruit* of strawberries, and which I believe has escaped the notice of many intelligent horticulturists. I shall relate those facts only which have fallen under my own observation.

On the 1st of May, 1820, I took up some young well-rooted runners of the Mathven-Castle strawberry, and planted them out in a bed, thinking they might produce a small quantity of inferior fruit late in the autumn; but, to my great surprise, on the 3rd of July, I was enabled to gather a considerable dish of very fine and well-ripened strawberries; and which were sent to London with other varieties, and exhibited at the Meeting of the Horticultural Society on the following day. These plants continued in bearing till about the 20th of August, which was about a fortnight later than the other crops; but they certainly were not quite so prolific as those planted out in August.

This year, so late as the 1st of July, I planted out several runners of the Roseberry; they grew so luxuriantly as in a few days to produce other runners; and on the 7th of September, I exhibited a plant to the Hampshire Horticultural Society, assembled at Winchester, bearing blossoms and several fruit, two of which were perfectly ripe, and of their natural size. Three other plants are now growing in the same bed, with above two dozen fruit upon them; but they do not swell and ripen very freely, owing to the very unfavourable state of the weather. From these results I am inclined to believe that if the young and well-rooted runners of the Roseberry, Wilmot's late scarlet, or common scarlet, are planted out in beds in an open situation about the beginning or middle of May, they will produce a considerable quantity of fine fruit, when all the other varieties have ceased to bear.

In communicating these observations, I hope they may lead to some valuable discoveries; at any rate they show how large and fine crops may be obtained: and from the

suggestions thrown out, the skilful cultivator may, perhaps, be induced to attempt the experiment of late spring planting; by which he will be able to furnish the dessert with a regular succession of this delicious fruit throughout the autumnal months.

Believe me, Dear Sir,
Very sincerely yours,
THOMAS GARNIER.

Bishop Stoke,
15th September, 1821.

LXXXII.—*On the Preparation of Hair Pencils and Drawing-Pens, for producing Fine Strokes.—By Mr.* EDMUND TURRELL, *Engraver. In a Letter to the* EDITOR.

[Concluded from p. 182.]

WITH FIGURES.

DEAR SIR,

46, Clarendon Street, Somers Town, October 22, 1822.

HAVING been in early life employed in a department of Art where the Miniature Hair Pencil was the principal tool used, it frequently occurred to me, that although there are great difficulties presented to the maker of that beautiful and delicate tool, to prevent perfection in it; yet that much might be done by a skilful hand to improve them, after they were obtained from the manufacturer.

In order to give the reader a correct idea of the improvement that may be effected, it will not be improper to explain, briefly, the method of manufacturing hair pencils. I shall first observe, that what are commonly called camel-hair pencils, are made of the hair of squirrels' skins and tails, imported from Russia and other countries where that beautiful little animal abounds. And as the improvement I am about to describe is more applicable to pencils made of that hair than any other, I shall confine myself to the description of that kind, at present; leaving the other kinds of hair to be considered afterwards.

When a tuft or bunch of hair is cut from the squirrel's skin or tail, if we tried to make a pencil of it in that state, we should find that some of the hairs being longer than the others, would, when the pencil was used, touch the paper first; and being bent by the pressure, would split or separate the rest, and thereby cause the pencil to work very imperfectly.

To avoid in some degree this imperfection, the workman has recourse to the following method:

Being furnished with a number of strips of pasteboard or card, about three-quarters of an inch broad, and from two to three inches long; each piece is coiled up in the form of a helical spring, and which form they retain in an expanded state, or when they are left to find their natural place of rest. The tuft or lock of hair sufficient to make a pencil of, is inclosed within one of the strips of card, which retains it loosely, and permits the hairs to slide by each other: this effect is produced, by tapping the card containing the hair upon a smooth board, the points of the hairs being downwards: by this method the longest hairs are driven upwards, and, finally, the points of the whole are brought nearly to the same level. The tuft of hair is then carefully taken out of the card, and tied with fine hempen thread, in which state it is fit to be inserted into the quill, after the fine downy roots have been previously cut off with scissars.

Now, although every care may have been taken to get all the points of the hairs down to touch the board, yet if they be carefully examined, the pencil will be found very imperfect in that most desirable quality. To remedy this imperfection, the pencil-maker has recourse to the following method:

Being furnished with a cylindrical piece of box-wood, about nine inches long, and one and a half inch in diameter, he places each end of it against the internal parts of each knee. By this means he forms a fixed horizontal bar:

and having wetted one of the pencils in his mouth, in order to bring all the points near together; the end, or point of the cone, thus formed, is laid or placed on the bar of box-wood, and is there submitted to the action of being brushed with a hair brush, such as is commonly used to shine or polish shoes with. The intention of this rubbing or brushing is, to wear away the projecting hairs, and thereby produce a more perfect point.

If we examine the hairs of such animals as are used for the purpose of making hair pencils, with a high magnifying power, each hair that is perfect and unbroken will appear to the observer to be a very acute cone; the part near the apex being so delicate as to be scarcely visible, owing to its being perfectly transparent; while the central part, or body of the hair is quite black or red, according to the colour of the animal. The reason for this will appear very evident when we consider that each hair is composed of tubes, which secrete and contain a fluid that gives colour to the hair; but as the tubes do not extend higher than the part where the colour is visible, the portion before named, near the apex of the cone, becomes colourless. I shall here observe, that it is this extremely fine portion of the hair that is so useful in miniature pencils: for where it is wanting, the pencil will work coarsely and with very great uncertainty.

From what has been now stated, it must appear evident that so delicate and minute a substance as that I have described, is very roughly treated, when it is submitted to the action of the finishing brush, to bring the ends of the hairs to an equal point. Indeed, it rarely happens that small pencils so treated are worth any thing for fine purposes, because that part of the hair which is the most essential, is completely destroyed.

When pencils of the small kind are wanted in a high degree of perfection, they should be obtained from the maker in an unfinished state; that is to say, just when they

are tied and inserted into their quills. In this state they are, however, totally unfit for use, for the reasons before shown; namely, the unequal length of their hairs.

To remedy this imperfection, the usual method adopted is, to cut some of the hairs that form the outside of the pencil away, with a sharp knife; so as to reduce, in a considerable degree, the quantity of hairs; taking the chance that what are left in the centre will produce a more perfect point. But, after trying many, it frequently happens that not even one can be obtained that will answer its intended purpose;—and this, there can be no doubt, is principally owing to the careless method adopted by the makers.

After experiencing great difficulty and disappointment, it occurred to me, that the imperfections here explained might be surmounted, by carefully selecting and removing all such hairs as were faulty, by the following method:

The pencils being procured in an unfinished state from the maker, those should be chosen that have the greatest length of the semi-transparent flue at their points. This quality will be best seen when the pencils have been wetted, and drawn out flat between the fore-finger and thumb; in which state they should be held up to the light, when their properties will appear more plainly. When a proper one has been chosen, it should be fixed upon a small stick or handle, with sealing-wax; and the hairs should then be cleansed with oil of spike lavender or spirits of turpentine, where the smell is not thought too offensive; either of these will dissolve a greasy animal oil that is frequently found upon the hair in its natural state; and this will be greatly assisted by drawing the pencil between the finger and thumb a few times.

The stick or handle being held in the left hand, the hairs of the pencil must be spread upon a piece of white porcelain; or, if it can be got conveniently, a watch-dial; and such hairs as are imperfect, either in their natural form, or that have been broken, are to be removed by the following means:

A piece or strip of box-wood, about the size of a small goose-quill, should be filed to a conical point, and finished very smoothly by scraping it with the edge of a piece of broken glass. A magnifying glass should be suspended over the porcelain or enamelled surface, and the pencil being placed thereon, it may be spread by the point of the piece of box-wood, and each hair closely examined.

Such as appear to be broken, and have lost the fine semi-transparent end or point, must be removed by pressing the point of box-wood upon them with the right hand, while the left hand that holds the pencil is withdrawn gently and gradually away.

If this part of the operation is successfully performed, the objectionable hairs will be completely drawn out and removed: but if they be too hastily removed, it is most likely that they will break, and only a portion of them be got away. This circumstance, even with the greatest care, will sometimes happen; especially when the pencil has been tied very tight, or the quill binds upon the hairs very firmly. It may perhaps be unnecessary to add, that all such hairs as have here been described, should be removed.

It sometimes happens that hairs imperfectly grown are found in the pencil. These must be in part removed; for the imperfection consists in a swelling or knot near the extremity, which, if left, would cause the pencil to split or work unpleasantly. The method of removing it is exactly the same as in the case of the broken hairs before explained. In all cases where the hairs break in attempting to withdraw them, it will be necessary to get them out as near to the tying as possible.

If the method here described be carefully performed, the pencil, when wetted and drawn to a point, will form a very beautiful acute cone, without any inequalities in the figure of it.

Although every care may have been taken, yet it will frequently happen that one, two, or more of the hairs will project beyond the others; and although it be not more

than the one-hundredth part of an inch, yet that, in such a delicate tool, will be quite sufficient to cause the pencil to split, and thereby work very uncertainly. The general method adopted to remedy this imperfection, is to lay the pencil (after it has been wetted and drawn to a point) upon a piece of ivory, and to cut off the points of the hairs that project.—I must own that although I possess a tolerably steady hand and keen eye, yet I never could perform such a task with any certainty; for when it is considered how very minute a quantity there is to be removed, it will not surprise any person if it is stated that perhaps two out of three are spoiled in the attempt: for the removal of the smallest portion more than is necessary, is so much taken from that which forms the most invaluable part of the pencil, and which no ingenuity can restore.

A more certain and easy way to effect the removal of the projecting hairs, I shall now endeavour to describe.

The pencil being thoroughly wetted, either with the saliva or with clean water, should be examined under a magnifying glass; and it will be seen that the capillary attraction of the hairs in the body of the pencil, will collect and retain the moisture in that part of the pencil which is above the extreme point, leaving the hairs which are too long completely exposed, and uncovered with moisture. This portion may be very easily and effectually removed by passing the pencil, in an horizontal position, through the flame of a candle, which will singe off the projecting and undefended hairs, leaving very minute bulbs visible at their points, which may be removed by drawing the pencil between the finger and thumb. I shall here state, that the greatest velocity which the hand and arm are capable of giving to the pencil in its passage through the flame, is necessary. But so easy of attainment is this velocity, that I can with confidence assert it may be done two or three times in succession, without producing any effect upon the hair at all. I mention these circumstances merely to shew that although the operation may appear a

dangerous one, yet in practice it is perfectly easy, and the means of effecting the desired purpose are under perfect command.

When the small knobs or bulbs are removed, if the pencil be wetted, and the hairs be in a slight degree spread either upon the piece of porcelain, or upon the thumb-nail, it will be seen, by using the magnifying glass, that the hairs at the extreme point are all of one equal length; the point or end of the pencil, so spread, appearing like the edge of a carpenter's chisel: and as by this method the extremely fine parts of the hairs, which carry on the capillary attraction to the very point, are perfectly preserved; it follows, that the moment such a pencil is brought in contact with the paper, that instant its touch will be rendered visible to the eye of the artist.

Fig. 4, plate XII., represents a miniature pencil, of the common size.

Fig. 5, shews the same object, upon a magnified scale. In this figure the projecting hairs at the point are shewn, which it is necessary to remove in the manner above described.

Fig. 6, represents a finished pencil spread open, in order to shew the equal length of the hairs at the point, where they appear like the edge of a chisel.

I shall here observe, that pencils of this kind are only fit for water-colours, or such delicate purposes as enamel-painting. But for oil-painting, the finest are the martin sable, which may be prepared in the same manner. But on account of the greater strength and spring of the hairs, pencils of sables' hair will never be so extremely delicate as those made of squirrels' hair. It is much to be lamented that, while sable pencils are selling at so great a price, a most valuable hair, equally suitable for the purpose of oil-painting, is totally neglected; namely, a beautiful white hair that grows under the hams of calves, and which, when made into pencils, are quite equal to the best sable. I remember some years ago to have seen some of these used

by Mr. Arnold, for landscape-painting, and who preferred them to every other kind*.—Should the hints herein contained conduce to the perfection of a most useful implement in the arts, it will give great pleasure to, Sir,

Yours very truly,

EDMUND TURRELL.

T. GILL, *Esq.*

LXXXIII.—*On Instruments for Drilling and Boring.*—*By the* EDITOR.

[Continued from p. 150.]

WITH FIGURES.

THE AMERICAN TWISTED CENTRE-BIT.

THIS valuable instrument is formed of a flat twisted bar of steel. See Plate XII. figs. 7 and 8; fig. 7, being a front view of it, and fig. 8, a side view. It will be seen from these figures, that this bit has its cutting-parts doubled, it having two wings or markers, one on each side; and two straight cutters, between them and the angular-pointed spike in the centre.

From this construction, it must be evident that this bit cuts much faster than the English centre-bits;—but this is not its chief merit. Owing to its twisted form, the cuttings or borings continually escape during the action of the bit, without requiring it to be continually drawn out of the hole to clear it of them, as is the case with the common centre-bits.

* Amongst other sources for procuring hair fit for pencils, the following may be enumerated;

Mr. J. J. Hawkins informed us, some years since, that in North America the hair which grew withinside the ears of cows was preferred. The hair which grows on each side of the head of a calf, in two particular tufts only, is said to be excellent for pencils. It is said that the *Lyons-tools*, or pencils, are made of the hair of swine. And, lastly, we were informed by the late Mr. W.E. Sheffield, who passed a considerable time at Rome, in the pursuit of the Fine Arts, that the famous *Roman Pencils* are made of the hair of embryo goats.—EDITOR.

We cannot too much recommend to our readers the adoption of this excellent tool; for the knowledge of which, the Editor is indebted to the kindness of Mr. JACOB PERKINS, who brought it over with him from America.

THE DRILL WITH HELICAL GROOVES.

This excellent drill (see fig. 9), like the American centre-bit, has the valuable property of clearing itself of the borings in use; which, in the lathe, is an object of great importance.

It is made of a solid cylindrical piece of steel, with two helical channels made along it, each terminating in front of the cutting edges at its point, and which very much contribute to add keenness to them, somewhat in the manner of the *drill for cast-iron*, described in p. 147 of this work.

This valuable instrument was likewise brought over from America by Mr. Perkins; but it is not quite unknown in this country. We recollect seeing, several years since, in a machine at Mr. Bramah's celebrated patent-lock manufactory, at Pimlico, *five* drills of a similar shape, boring as many holes at once in plates of brass; and had it not been for this valuable property of clearing themselves of the borings, we can hardly conceive how they could have answered their purpose.

OF THE AMERICAN GIMLET WITH HELICAL GROOVES.

This very superior instrument (see fig. 10) is made, like the drill just described, of a solid stem, with two helical grooves made in it, terminating in front of the two flat cutting edges at its end; and it has in the middle of them, a conical double-threaded screw.

The consequence of this arrangement, is, that on being once entered into the wood to be bored, it makes its way of its own accord, continually freeing itself of the borings; and boring a straighter and smoother hole, and in less time, than any gimlet we have ever met with.

We cannot speak to favourably of this excellent contrivance, which we likewise had from Mr. Perkins; and we

trust that we shall soon see these gimlets, as well as the centre-bits, in that universal employment amongst us, which the *screw-auger*, (perhaps the original of all these improvements,) already meets with in this country.

ON A TWISTED BORER, FOR MINING, WELL-SINKING, &c.

Mr. Perkins has assured us, that he has bored for water, &c. in America, with a *twisted bit* of his own invention; and which had the valuable property of causing the earth, &c. to escape at the surface, of their own accord; and without requiring the bit to be continually drawn up, as must be done with the common boring-bits, when choked up with the earth, &c. to clear them; and with a great loss of time, and of course a prodigious addition to the expense of boring deep holes.

We need scarcely point out to the notice of our readers, how very desirable it would be for such bits to be employed, in the present rapidly extending mode of boring for water, through the bed of the London clay, in the vicinity of the metropolis, or in similar situations: and we regret that we have it not in our power to give the particulars of the construction of these valuable instruments.

(*To be continued.*)

LXXXIV.—*On a new Material for the Manufacture of Buttons, &c. By the* EDITOR.

WITH FIGURES.

We have lately seen some Buttons, brought from Antwerp, and were particularly struck with their beautiful polish and neatness of finish. In other respects, they resembled the buttons made from horn; but, on inquiry, it turned out, that they were made of the thick shells of cocoa-nuts. These are generally thrown away in this country, as useless; or at most, merely employed as fuel: their cost, therefore, would be trifling, possibly little more than for the trouble of collecting them.

The buttons were of two different kinds; the handsomest were dyed black, and had white ivory cones in their centres, being the ends of their screwed shanks. In Plate XII. fig. 11, we have given a section of one of them, in which is shewn the form of the hollowed conical face of the button, and the screwed conical ivory shank in its place. The other sort was of a much simpler construction, they being turned solid, and having shanks with holes through them to fasten the buttons on with. One of these is shewn edgeways in fig. 12.

These buttons are much used in the Netherlands, and are also particularly adapted for the use of seamen; as they are very durable, not being subject to swell and split when wet, as those made of horn continually do; nor to soften, like the leather buttons; these being the two kinds mostly used for this purpose.

These buttons, being formed of so hard a material, will require to be made in the manner of bone-moulds, or pearl buttons.

It is singular, that although the *small coquilla shells* are much employed by the turners in this country, *yet that no use is made of the larger shells of the cocoa-nuts.* Possibly this notice may lead to the employment of them for many purposes, in which, from their great hardness, and the beautiful polish and finish they are susceptible of receiving, they will be found highly valuable.

LXXXV.—*On the Culture of Hyacinths. By the Hon. and Rev.* William Herbert, D.C.L., *Member of the London Horticultural Society. In a Letter to the Secretary*.*

Dear Sir,

The Dutch mode of treating Hyacinths has been fully detailed in a work by St. Simon, entitled *Des Jacintes*, published at Amsterdam in 1768, in 4to., in which every thing that can be said, and a great deal more than need be

* From Vol. IV. of the Society's Transactions, for 1822.

said about a hyacinth, will be found. Complying with ST. SIMON's directions as nearly as possible, I produced for several years successively, at my villa in Surrey, where I had the advantage of the vicinity of the fine sand of Shirley-common, hyacinth flowers fully equal, if not superior, to those obtained from the best Dutch bulbs: but since my collection of plants has been removed to this part of Yorkshire, where fine sand can only be obtained by the tedious process of breaking stones and reducing them to powder with an iron hammer, I have been prevented from cultivating them with equal success.

The compost used at Haarlem is rotten cow-dung, rotten leaves, and fine sand. In making this compost the Dutch gardeners prefer the softer leaves of elm, lime, and birch, and reject those of oak, chestnut, walnut, beech, plane, &c. which do not rot so quickly. The cow-dung which they use is also of a peculiar quality, being collected in the winter, when the cattle are stall-fed upon dry food, without any mixture of straw or other litter. The sand is procured in the neighbourhood of Haarlem, where the soil is a deposit of sea-sand upon a compact layer of hard undecayed timber, the remains of an ancient forest which has been overwhelmed by the sea. The purest sand is procured by digging to some depth. ST. SIMON imagines that this sand has peculiar virtues, in consequence of an admixture of salt and sulphur, but I believe he is mistaken; for in order to judge of the effects of sulphur, I placed a hyacinth on a glass full of sea-sand, having sprinkled on the surface some fresh sulphur which I had scraped off Hordle Cliff, in Hampshire; and the bulb refused to vegetate or push any fibres till the sulphur was removed.

The leaves used by the Dutch are laid in a very large heap, in a situation not much exposed to the sun, and not liable to stagnation of water, which is carefully drained from them. When they are decayed and fit for use, the compost is thus made: First, they place a layer of sand,

then one of dung, and then one of rotten leaves, each being eight or ten inches thick. These layers are repeated till the heap is six or seven feet high, a layer of dung being uppermost, sprinkled over with a little sand to prevent the too powerful action of the sun upon it. After the heap has lain thus for six months or more, it is mixed and thrown up afresh, in which state it remains some weeks to settle, before it is carried into the flower-beds. This compost retains its qualities about six or seven years, but the Dutch avoid setting hyacinths in it two years successively; in the alternate years they plant tulips, jonquils, narcissuses, crocuses, fritillarias, lilies, irises, &c. in the same beds; nor do they venture to set hyacinths in the compost the first season, when the fresh manure might be injurious to them. The choice bulbs are taken up every year, and the soil that lay amongst the fibres is then carefully brought up to the surface. The beds should be deep enough to prevent a possibility of the fibres coming nearly in contact with the natural soil.

I believe that English sea-sand, or that which the London nurserymen obtain from the neighbourhood of Croydon, will suit the cultivation of hyacinths as well as that of Haarlem. Where the leaves of elm, &c. cannot conveniently be kept distinct, I imagine that other leaves will serve the purpose as well, if they are left a much longer time to rot; and even old tan, if thoroughly decayed and pulverized, may be used instead of leaves, since the Dutch have tried it with success. The difficulty is to obtain in this country cow-dung without straw: it may however be collected in the fields, although being the produce of green food, and dried before it is collected, it will not perhaps have the same virtue as that used by the Dutch; and if it is necessary to use that from the farm-yard, it should be taken as free from straw as possible, and from the cow-house door, without any mixture of other dung, which would be prejudicial; and it must be completely decayed before it is used. The mischief occasioned by the fermen-

tation of half-rotten straw, and the too great heat of horse-dung, &c., is a contagious decay amongst the bulbs, which will spread throughout the bed: the cause of this decay appears to me to be a fungus, the spawn of which is nurtured in the dung. The Dutch with all their precautions are very much troubled by this disease; the only remedy for which is the removal of the distempered bulb, and the compost that was in contact with it; and the cure of the bulb itself, if the injury has not gone too far, may be effected by amputation of the diseased coats.

The beds should be made about three feet in depth with the compost, consisting of about one-sixth of rotten leaves or tan; two-sixths of pure sand, and three-sixths of rotten cow-dung. The compost should not be trodden down hard; but the bed being opened, the bulbs may be ranged, and then carefully covered from three to five inches deep, but they should not be dibbled or pressed into the compost. The later sorts may be placed nearer the surface, to make them flower earlier.

If the situation is wet in winter, the beds may be raised six inches, or even more, above the level of the soil, to prevent the injury which the bulbs might receive from moisture; but if too much elevated, they will suffer from drought. The Dutch cover their beds with dung or tan in winter, which they frequently put on or take off, according to the state of the weather. They like the frost to penetrate to the distance of an inch from the bulb; if it descends deeper, they consider that the blossom will be spoiled; and if it reaches the roots, that they will be destroyed. I have never found the frost injurious to the bulbs, though I used no covering; but the winters are more severe in Holland than in England. The compost will require no additional manure till the expiration of about six years, when it should be mixed with fresh sand and dung, prepared as before.

When the leaves of the hyacinths begin to wither, the bulbs should, if possible, be pulled out of the bed by the

hand, to avoid the danger of cutting them with the spade. The leaves should be cut off, and each bulb laid on its side, covering it lightly with the compost, about two inches thick: in this state they should be left about a month, (but the tardy sorts are usually left longer, and more lightly covered,) and then taken up in dry weather, and exposed to the open air for some hours; but not to a powerful sun, which would be very injurious to them: they should, after this, be carefully examined, and all the decayed parts removed by a knife, for which purpose it will sometimes be necessary to cut deep. An extravasation of sap, or lodgment of moisture within the coats, will cause a local decay, which, if the diseased part be not carefully and entirely cut out, will spread over the whole bulb, and become contagious amongst those which are near it.

The bulbs should be placed in the store-room, which ought to be airy, about the end of June; they must not be suffered to touch each other; and should be frequently examined, in order to remove those which may shew fresh symptoms of decay. If few in number, a moveable stage of very open lattice-work should be used, which may slide upon castors, and be set in any dry, cool, and airy room. If the stage be large, it should be furnished with many ranges of drawers, just deep enough to receive the bulbs, at intervals of about six inches in height, or more. When the bulbs are numerous, they will require an entire store-house; this may be constructed with planks, and consist of two stories, the lowest of which must be raised from the ground upon posts; it should, if possible, be ventilated by long apertures on three sides, the shutter of each aperture being a plank six or seven feet long, and about a foot wide, made to turn like the laths of a Venetian blind; and when damp westerly winds prevail, the shutters must be nearly, if not entirely, closed. The bulbs in this place should be ranged on tables, or stands raised one above the other, with an interval of between two and three feet in height between the tiers, to give free access to the air. Before

they are planted in the autumn, they ought to be again carefully examined, and all decayed parts and withered coats removed.

My own experience enables me to say, that any nurseryman in the neighbourhood of London, who will take the trouble of following the directions given in this letter, may produce hyacinth bulbs, equal, if not superior, to those imported from Holland; though, perhaps, with greater loss from disease, owing to the quality of the dung he may be necessitated to use. I have no doubt but that nurserymen might cultivate hyacinths, and Cape bulbs alternately, with great success in the compost described, using the precaution of placing white sand round the Cape bulbs, which would otherwise be cankered by the manure, and, when diseased, would become the prey of centipedes and small maggots. Pure sand placed in contact with the hyacinth bulbs might be a preservative to them also: and if the dung cannot be obtained without a mixture of rotten straw, perhaps a larger portion of sand may be adviseable. I should not be surprised, if watering the compost before it is used, with salt water or brine, should prove of some use, supposing a fungus to be one of the causes of mischief; for after trying many other things in vain, I found salt to be the only remedy for the tanner's fungus, which is so troublesome in tan beds, and in the pots of earth in the stove. Those who still use tan, which I have not admitted for the last six years into my stoves, will perhaps find it useful, on that account, to wet their tan with salt water before they use it. I am, Dear Sir,

Yours very truly,

WILLIAM HERBERT.

Spofforth, June 27th, 1820.

LXXXVI.—*On an improved Physeter, or Percolator, and other Filtering Apparatus; and also on a Drying Stove, and on a Compound Press, used for making Madder and other Coloured Lakes.* By Mr. GEORGE FIELD.*

WITH TWO PLATES.†

Heath Cottage, Reading-Road, Hounslow, Nov. 1, 1814.

SIR,

I HAVE the honour to lay before the Society of Arts, &c. the plan of a very simple and efficacious machine, called a *Physeter*, or *Percolator*, for filtrating liquids with great expedition. Its powers are too evident upon the face of the enclosed plan and description, to require certifying; and the machine itself may be seen in use.

I have the honour to be, Sir,

Your obedient humble servant,

To C. Taylor, M.D. Sec. G. FIELD.

The Committee of *Chemistry* went to Mr. Field's, at Hounslow, and inspected the *physeter* while in use: and in consequence of its favourable report, the Society voted its GOLD ISIS MEDAL to Mr. Field, for this, and the other apparatus used by him, for preparing madder lake, and other coloured lakes; and of which the following description was afterwards furnished by Mr. Field.

SIR,

In compliance with the desire of those gentlemen of the Society of Arts, &c. who did me the honour to inspect my apparatus, that I should extend my late communication, I beg to submit to the Society, first, the following more perfect description of my *physeter*, or *percolator*.

In Plate XIV, fig. 1, is a vertical section of the machine.—

* From Vol. XXXIV. of the Transactions of the Society of Arts. Considerable alterations have, however, been made in the arrangement of this article, with a view to connect the various subjects, which are so much dispersed in the original, as to throw great obscurity in the explanations of them.—EDITOR.

† The Plates belonging to this Article will be given in our succeeding Number, at the conclusion of the Article.—EDITOR.

a, a strong tub. *b*, a hoop fixed therein. *c*, a small lifting pump. The strainer, *c*, is covered in the first place with woollen baize, and secondly with silken cloth of the kind called lutestring, their edges being passed over the rim of the strainer; the space between which and the tub is securely packed air-tight with a list of woollen cloth; the whole is then secured by the hoop, *f*, the ends of which, *ff*, touch each other within the tub; and the hoop, by driving, fits so closely to the sides of the tub, and on the rim of strainer, *c*, as to render the whole air-tight, and secure the packing in its place; and it is further secured by copper nails driven through it.

Fig. 2, is a section of part of the strainer, on a larger scale, which shews how the strainer, baize, and silk, are packed.

Fig. 3, is an elevation of the whole machine, shewing the pump, *d*; two cocks, *g* and *h*; and a funnel, *g*, by which the bottom part may be filled with water, the air escaping at the cock, *h*, which saves time, as the first stroke of the pump lays the whole weight of the atmosphere on the filter; the cock, *h*, also serves to regulate or diminish the force of the exhaustion, by letting air in again below.

Such is the plan of this machine in its most simple form. It is, however, capable of numerous variations, among which are principally worthy of notice—First, that it may be reversed. Let the under space be *open* to the atmosphere, and the top of the tub *closed* air-tight, except a small opening to communicate with an apparatus for *injecting* the percolating liquid, or air, to press upon it. And, secondly, the plan of *exhausting* the under space, may be combined with the present, of injecting the space above; of course, with double power. The purpose, however, for which I filter, will determine the best mode of applying my principle;—if such purpose be the purification of liquids, the mode of injection may, in some cases, be the most appropriate; and when precipitates, or the matters to be separated from liquids, are the objects of filtration, the mode

of exhaustion may be the best: in the first case by a *forcing*, and in the latter by a *lifting-pump*.

Pure water is so essential an article of life, that a filtering machine is almost indispensable on board of every ship, and in most chemical arts it is highly necessary. The present plan is both portable and compact, equally adapted to sea-service as to domestic use. When applied to the purification of water, it may be used simply as a pump, since the withdrawing of pure water for use, prepares the machine for a new supply, in resemblance of the well or fountain; at the same time that no dirt, or extraneous matter, can possibly get into the purified water. In this latter use, the addition of some sheets of filtering paper, or other proper medium, between the cloths of the strainer, will be requisite; but in separating or collecting precipitates (for which this machine was constructed), this addition is unnecessary.

OF OTHER FILTERING APPARATUS.

Fig. 4, a tripod or moveable stand, constructed with two hoops, about sixteen inches in diameter, and three legs, two feet three inches high:—*i*, a filter, made of a conical bag, placed within a hoop, over which the edge of it is returned, and secured by another hoop fitted tight over the first, as shewn at fig. 5. *k*, a lid, to keep the materials clean. This filter rests loose on the tripod, and may be easily changed; another filter may also rest on the lower hoop, *l*, as shewn by dotted lines, to farther purify the fluid when needful.

Fig. 6, shews a simple method of supporting filters against a wall, by the two rails, *l*, *m*; the rail *m*, being placed the thickness of the hoop (two or three inches) lower, and forwarder than the other.

Fig. 7, is a screw hoop, for filters of very large dimensions, in which a conical bag of net-work, or strong canvas, is fixed, to support the filtering medium.

Fig. 8, is a thick board, with fluted conical holes in it, to support a number of small filters of cloth, silk, or paper, placed over a basin, as at fig. 9.

Figs. 10 and 11, exhibit the means by which conical bags are formed of a double square of silk or cloth, *n*, *o*, *p*, *q*, fig. 10, folded at *n*, *o*, and the edges sewed in a flat seam from *q*, to *p*: and thus half a yard of yard-wide cloth forms this filter. When the filtering angle at *o*, fig. 11, is worn out, a second may be formed by the same means at *n*, first unripping the former seam, and so on at the other two angles; thus making it both durable and economical, it lasting four times as long as is usually the case with filters.

Fig. 12, is a small filter, formed of a square of silk or cloth, merely by twice folding it across.

OF AN IMPROVED AIR-STOVE.

The next article I am desirous of submitting to the investigation of the Society, is an *air-stove*, being a simplification of the drying-stove, formerly honoured by the Reward of the Society.

The draft of this stove is so good, as to reduce small pit-coal and ashes to a slag; yet, the interposition of air between the fire and the chambers of the stove, so moderates and regulates its action, as never to produce a scorching heat therein.

Plate XV. fig. 1, is a perspective view of part of the *drying-stove*, shewing a vertical section through the flue, between the hot-closets, and one of the closets open; and having the three bottom stages separated, to shew their construction better.

a, the ash-pit in the first or bottom stage, supplying air to the fire, *a*, in the second stage; the flue of which pursues the course indicated by the arrows, *a*, *a*, *a*, &c. over the air-course of the first stage, and under the air-course of the third stage, thus making the air very hot; then rising through the third stage at the back corners, *a a*, and above the iron floor, *c*, *c*, of the two closets, the right and left currents unite in one flat or thin flue, extending from back to front between the two closets, (as shewn in the section,) the partial partition, *d*, being put, to make the smoke travel to

the front; and then back again to ascend the chimney, *e*: each course being separated from that above it by cast-iron plates, with apertures in them where necessary. *b*, *b*, the two air-courses in the bottom stage, which unite and ascend through the second stage at the back of the fire, into the third stage, where they divide again right and left, travelling all over the fire-flue, by the courses shewn by the arrows, *b*, *b*, *b*, &c. and joining over the fire, they divide; the air being then very hot at *f*, enters into the right and left closets, *g*, *g*, fig. 4, where, travelling in a zigzag course between the iron or copper tinned trays in each, they join again in *h*, and the air finally escapes into the flue, by the register, *i*: the arrows, *a*, *a*, &c. shewing the fire-flue; and the arrows, *b*, *b*, &c. the air-course all the way to the register, *i*.

Fig. 2, is a section of the left chamber, shewing the current of hot air between the trays, entering at the bottom, *b*, and escaping, as shewn by the arrow, *b*, at top.

Fig. 3, shews how the trays are placed alternately over each other, and are each supported on two iron bars, *k*, *k*, &c. let into each course of brick-work.

Fig. 4, a perspective view of the whole stove in action; *a*, the ash-pit; *b*, *b*, the air-courses, and the register, *i*, open, the chamber doors, *g*, *g*, shut; *h*, *h*, the top of the flues.

The principle of this stove is applicable also to the heating and circulating of air within a room, for the purposes of health and comfort, as well as drying, either by a *close* or *open* fire-place; and I have succeeded in rendering two remarkably cold rooms exceedingly warm and comfortable, by its use.

The heat and rarefaction of the air, by an iron arch over the fire, causes it to pass in a free current through the ventilator into the room, communicating *salutary warmth without closeness*. The smoke of the fuel passes back, under the crown of the fire-place, and rises behind it into the chimney.

[*To be concluded in our next.*]

LXXXVII.—*On the Cultivation and various Uses of the Syrian Asclepias.**

This Plant is originally from Syria; and although a native of very hot climates, yet it bears the severest cold of European winters uninjured. Its stem decays every year, and it is reproduced from its roots.

The Asclepias bears a small fruit, which opens when ripe, and exposes to view silky tufts, which envelope its seeds. This kind of silk, which is one or two inches in length, has caused this plant to be termed the *silk-tree*, or the *wadding-plant*. Its Linnean name, however, is *Asclepias Syriaca*.

We may multiply this plant either by sowing its seeds in the spring, or by means of suckers from its roots. When it is transplanted, the plants must be placed at the distance of at least five feet apart, because the roots of this plant extend themselves every way in a surprising manner; and it is astonishing, after the third or fourth year, to see the ground covered with its stems. If its multiplication is not impeded, it increases and spreads over the surrounding fields, with surprising rapidity, and especially if the soil is soft and light; it is useless, therefore, to plant it in a good soil.

After successful experiments made by several persons, it is proved that this plant offers a new branch of industry; it has been manufactured into hats, stockings, caps, velvet, flannel superior to the English, satin in imitation of that from India, and superfine cloth, equal to that made from Spanish wool, &c.

When the fruit begins to open, they cut it, and leave it to dry. After this desiccation the silky tufts are separated from the seeds, and inclosed in bags. To card this silk, which is so light that it would fly away with the least breath of air, they expose the bags containing it to the action of steam. It may be carded alone; but it is much easier done by placing alternately layers of cotton and of this silk—the cotton affording strength to it. This material is susceptible of being readily dyed.

* From the *Dictionnaire Technologique*.

Even should it not be employed for the purposes of manufacture, yet it would be highly desirable to cultivate it, to serve as a stuffing or wadding in place of cotton wool.

The stalks of this plant, after being treated by steeping in water, in the manner of those of hemp and flax; when dried and dressed, afford very long filaments, which are beautifully white and shining.

Under all circumstances this plant well merits cultivation; it succeeds perfectly in soils of a middling quality, and it grows wild on the Downs near Rochelle.

LXXXVIII.—*On Bronze Powder. By the* EDITOR.

THE very great use made of this article in the decorative Arts at this time, renders it an object of considerable importance.

From its impalpable form it is evident that it must either be a metallic precipitate; or, which is most likely, and is indeed confirmed by the testimony of several respectable chemists, that it is made from the *Aurum Mosaicum*, or *Aurum Musivum*, for it has both these names.

The late Mr. W. E. Sheffield, who was formerly a manufacturing chemist, informed us of this fact, as far as regards the gold-coloured bronze: but we have also bronzes of other colours, as orange, green, white, &c. which must be formed of other preparations.

PARKES, in his "*Chemical Catechism*," also mentions the employment of *Aurum Musivum* (mosaic gold) by artists, to give a beautiful colour to bronze. He terms it a combination of the white oxide of tin with sulphur, by means of mercury.

DOSSIE, however, in his valuable work, "*The Elaboratory laid open*," gives the best process for its preparation, and which is as follows:

"*Aurum Mosaicum.*

"Take of tin, one pound, of flowers of sulphur, seven ounces, of sal ammoniacum and of purified quicksilver, each half a pound: melt the tin, and add the quicksilver to it: when the mixture is become cold, powder it, and mix it

intimately with the sal ammoniacum and sulphur, then sublime them in a matrass; the *aurum mosaicum* will be found under the sublimed mass, with some dross at the bottom of the matrass.

"*Note.*

"The proportions of quicksilver and sal ammoniacum also, are, in this process of the College, less, by one half, than in those of the Edinburgh Pharmacopœia, and other books; but, being sufficient to answer the end, this diminution is a real improvement of the preparation, as considerably lessening the expense.

"The conduct of this process is somewhat critical, for it very often miscarries; at least, with respect to the quantity of the perfect produce: as, frequently, only a small part of the cake is found of the due colour and brightness.

"In order therefore to avoid the causes of this failure, it is best to scrape off and pick out, all foul parts of the sal ammoniacum; and to take care that the tin and quicksilver, particularly the latter, be not adulterated with lead.

"The calcination is best performed in a coated-glass body, in the naked fire; for there is no certainty in a sand heat, of raising the cinnabar formed by the quicksilver, entirely from the tin, without a longer continuance of the heat than is consistent with the success of the operation in the main point. The coated body should be of a very long form; and little more of it should be exposed to the heat in the cavity of the furnace, than the part containing the materials. By having a great part of the body out of the heat, the whole of the sal ammoniacum and quicksilver may be preserved; as the sal ammoniacum will be collected with part of the sulphur near the top of it; and the quicksilver, with the other part of the sulphur, combined in the form of cinnabar, nearer to where it is exposed to the fire: the sal ammoniacum thus saved, may be used for making the volatile spirit; for which purpose, the sulphur commixt with it will no way injure it: and the quicksilver converted into cinnabar, may be, with any other quantities of foul cinnabar,

or calomel, revived by distillation with quick-lime and pearl-ashes; and, by this means, the principal expense in making the *aurum mosaicum* reimbursed."

The *aurum mosaicum*, after being finely levigated, is used by coating the articles to be ornamented with it, either with oil-paint or varnish; and, whilst in a partly dry state, applying the bronze-powder to the parts intended to be bronzed with a fine and loose hair-pencil.—EDITOR.

LXXXIX.—*An Improvement in the Manner of applying the French Varnish or Polish. By Mr.* SAMUEL NOCK.*

THIS improvement consists in the substitution of a sponge, with a smooth surface, in place of the coil of list of woollen cloth, or drugget, commonly used†.

Mr. Nock finds the sponge to be far more convenient for applying the varnish to the surfaces of gun-stocks, than the list or drugget; as it has no loose hairs like the latter articles, which are continually protruding through the linen cloths in which they are inclosed, to the great injury of the process. He also finds, that he can fill the sponge at once with a considerable quantity of the varnish; and can bring it to the surface of the linen cloth, when required at any time, by squeezing the sponge; and he is thus enabled to continue the operation for a much longer time without renewing the varnish.

When the sponge becomes clogged with varnish, he moistens it with alcohol; and, putting a coarse linen cloth over it, employs it to prepare the gun-stocks for receiving the varnish; as also to remove any former varnish, oil, &c. He however always employs a fine linen cloth in finishing his varnishing.

He adds, that a Frenchman of his acquaintance has informed him, that in France they find the introduction of camphor to improve the varnish.

* Of the Regent's Circus, Piccadilly. † See Vol. I. p. 356.

XC.—*On the French Chemical Apparatus for the Manufacture of the Nitric and Hydrochloric Acids**.

WITH A PLATE.

Having, since the publication of our articles "On the Manufacture of the Nitric and Hydrochloric Acids in France," received the Plate of the apparatus employed in their manufacture, termed "*the cylinders*," we hasten to lay it before our readers.

In Plate XIII. fig. 1, is a section of one of the cylinders and fire-places, and two of the receivers, &c. Fig. 2, an end view of the three fire-places, with the cylinders, &c.

A, A, &c. cast-iron cylinders.

B, B, &c. cast-iron plates, which fit into and close the ends of the cylinders.

C, C, &c. tubes of communication.

D, D, earthenware bottles with three tubulures.

E, door of the furnace.

F, F, &c. furnace-grates.

G, G, &c. ash-pits.

H, the furnace chimney.

I, I, I, plates of cast-iron, extending the whole length of the cylinders.

K, refrigerator, in which all the bottles of the first row are plunged.

XCI.—MISCELLANEOUS.

A Novel Plan of Economising Fuel for Domestic Purposes.

The following paragraph has, during the last month, appeared in several of the daily papers, viz:

BEST MODE OF LIGHTING A FIRE.

"Fill the grate with fresh coals quite up to the upper bar but one; then lay on the wood in the usual manner, rather collected in a mass than scattered; over the wood place the cinders of the preceding day, piled as high as the grate will

* From the *Dictionnaire Technologique*.

admit, and placed in rather large fragments, in order that the draft may be free: a bit or two of fresh coal may be added to the cinders when once they are lighted, but no small coal must be thrown on at first. When all is prepared, light the wood, when the cinders in a short time becoming thoroughly ignited, the gas rising from the coals below, which will now be affected by the heat, will take fire as it passes through them, leaving a very small portion of smoke to go up the chimney.

"One of the advantages of this mode of lighting a fire is, that small coal is better suited to the purpose than large, except a few pieces in front, to keep the small from falling out of the grate.

"A fire lighted in this way will burn all day, without any thing being done to it. When apparently quite out, on being stirred, you have in a few minutes a glowing fire.

"When the upper part begins to cake, it must be stirred, but the lower must not be touched."

REMARKS BY THE EDITOR.

We know not the author of this paragraph; but the advantages attending the method indicated, appeared so evident to us,—after the experience we have had of the patent gas grates, invented by Cutler, and of Hawkins's patent shovels for feeding grates with fresh coals laid underneath the burning fuel,—that we lost no time in putting the method to the proof; and, we must say, with complete success.

The grate experimented with, was a common Bath-stove, about fourteen inches wide at the top; and we found that a fire lighted in the manner recommended, at eight o'clock in the morning, continued burning until five in the evening, without being touched in the slightest degree.

We have also found that when, in addition to the directions above given, care had likewise been taken that all the apertures, by which air might have entered at the bottom of the grate, were well closed, either by leaving them covered with the dust and ashes of the former day's fire, or by

means of the small-coal dust contained in the fresh coal with which the fire was made; that then it would continue burning with a smouldering heat for thirteen or fourteen hours at a time, and with so little consumption of fuel, that at any period, even at the end of so many hours, upon being stirred up, and the air admitted, a lively fire would be produced. Had however the passages for air at the bottom of the grate been left open, and the fire made with coal consisting of lumps, without the mixture of dust, it would have been consumed in a much shorter time.

It is not to be supposed, that a fire which will last so long, and with so little trouble and expenditure of fuel, can give out much heat; yet it is sufficient to keep up a moderate degree of warmth; and it is certainly a very desirable thing to be furnished with the means of keeping a fire a-light for so many hours, without any attendance.

We have only to add, that we have since repeated these experiments with complete success; and are so perfectly satisfied with the method, that we can confidently recommend it to the favourable notice of our readers; and, in particular, to the studious, who often suffer from the fire going out when neglected.

Queries—On rendering Woollen Cloth Water-proof, by means of Acetate of Lead; and on Cutting, Polishing, &c. Cornelians and Pebbles. By a CORRESPONDENT.

SIR,

AT the earnest suggestions of many of my friends, and your constant readers, I now take the liberty of addressing myself to you to propose two Articles, in the next or some subsequent number of your valuable Repository. The first I take the liberty of proposing, is the minute particulars of the method of rendering woollen cloth water-proof by the use of the acetate of lead, which you hinted at in a former number*. The other is an Article which I think

* We shall feel grateful to our worthy Correspondent who favoured us with the hint of rendering woollen cloth water-proof, for any additional information he may please to afford us on this important subject.—EDITOR.

will interest most of your readers, since it relates to a process which is at present but little known to the public. The process I allude to, is the cutting, dividing, grinding, and polishing of cornelians and pebbles; the collecting of which has of late become so fashionable an amusement, particularly with the fair sex*.

If, Sir, you should feel disposed to favour us with the desired information, I shall always remain your humble and obliged servant,

F. E. W.

Sept. 25, 1822.

Swiss Machine for making Bread:—and on an American Churn.

A MACHINE has been introduced at Lausanne, in Switzerland, for making bread,—that is, for promoting the fermentation of the dough,—which seems to deserve imitation in other countries. It is simply a deal box, a foot in breadth and height, and two feet in length, with pivots at each end, placed on supports, and is turned by a handle, like the cylinder used for roasting coffee. One side of the box opens on hinges, to admit the dough, and the box is then turned round†. The time requisite to produce fermentation depends on the temperature of the air, the quickness of turning, and other circumstances. But when the operation is performed, it is known by the shrill hissing of the air in making its escape, which generally happens in half an hour. The leaven is always extremely well raised, perhaps even too much sometimes. The labour is nothing; for a machine, such as is here described, may be turned by a child. No hooks, points, cross-bars, or any other contrivance, can be wanted within the box, to break or separate the mass of dough; for these operations are sufficiently effected by the adhesion of the dough to the sides of the box.

If the machine be made of greater length, and divided

* We shall endeavour, in the course of our undertaking, to gratify our Correspondent herein.—EDITOR.

† The American Churn is a precisely similar Machine.—EDITOR.

by partitions at right angles to the sides, different kinds of dough may be prepared at the same time.

One evident advantage of such a contrivance is, that bread manufactured in this way must be perfectly clean, and free from accidental soiling.

Interesting Example of Electrical Attraction.*

We have had occasion recently to observe the process of applying gold-leaf in gilding the frames of looking-glasses and pictures. It is probably known to many persons, that the frame, after being prepared by a composition, which is laid upon it with a brush, is moistened with gin, or some other spirit. The gold-leaf, cut up by a round-edged knife, is taken up on a flat hair brush; and this is brought, with the gold downwards, very near to the place to which it is to be applied. When it comes within a short distance, generally about half or three quarters of an inch, without any farther attention from the artist, it flies from the hair brush to the surface on which it is to be laid, and clings to it, and embraces it with such exactness, as to cover every roughness. The gold, apparently, makes just such an effort as it does when attracted in the gold-leaf electrometer; and it appears to arise from the same cause, viz. an electrical attraction. This attraction is obviously produced by the evaporation of the spirit.

Evaporation is well known to produce electrical excitement, and to generate opposite states of electricity in the contiguous bodies. We should, therefore, expect the attraction to be strongest, in the case of those bodies which evaporate most readily; accordingly the gold-leaf is less powerfully attracted when water is substituted for spirit.

The success of the gilder appears, in these cases, to depend very much on the exertion of a principle which he is very little aware of. It would seem that, but for this, it would be scarcely possible to apply the leaf with entire pre-

* From *Silliman's American Journal of Science and Arts.*

cision to all the varieties of surface produced by the carver. We have thought it worth mentioning, as a happy illustration of a scientific principle, occurring in the practice of the Arts.

LIST OF PATENTS FOR NEW INVENTIONS,

which have passed the Great Seal, since Sept. 27, 1822.

To John Collier, of Compton-Street, Brunswick Square, in the county of Middlesex, Engineer; for certain improvements upon Machines for Shearing Cloth. Dated Sept. 27, 1822.—To be specified in two months.

To William Goodman, of the city of Coventry, and the borough of Warwick, Hatter; for certain improvements in Looms. Dated Sept. 27, 1822.—In six months.

To John Bourdieu, of Lime-Street, in the city of London, Esq.; in consequence of a communication made to him by a certain foreigner residing abroad, for a method or means of improving the Preparation of Colours for Printing Wove Cloths. Dated Sept. 27, 1822.—In six months.

To Benjamin Boothby, of the Iron Works, Chesterfield, in the county of Derby, Iron-Master; for an improved method of manufacturing Cannon-Shot; by which, a superior Shot is produced in the solidity and smoothness of its external surface. Dated Sept. 27, 1822.—In two months.

To John Dowell Moxon, of Liverpool, in the county of Lancaster, Merchant and Ship-owner; and James Fraser, of King-Street, Commercial-Road, in the county of Middlesex, Engineer; for certain improvements in Ship's Cabooses, or Hearths; and also for Apparatus to be occasionally connected therewith, for the purposes of Evaporating and CondensingWater. Dated Sept. 27, 1822.—In six months.

To Frederick Louis Talton, of New Bond-Street, in the county of Middlesex, Watch-Maker; for certain improve-

ments in, or additions to, Watches or Chronometers in general; whereby they may be produced capable of marking or indicating the precise moment of any desired observation, or rapid succession of observations; and without the necessity of stopping the regular movement of the watch, as in ordinary Stop-Watches. Dated Sept. 27, 1822.—In two months.

To Thomas Timothy Binningfield, of High-Street, Whitechapel, in the county of Middlesex, Tobacco Manufacturer; and Joshua Taylor Beale, of Christian-Street, Saint-George's in the East, Cabinet-Maker; for certain improvements on Steam-Engines. Dated Sept. 27, 1822.—In six months.

To John Whitcher, of Helmet-Row, Old-Street, Saint Luke's, in the county of Middlesex, Mechanic; Matthew Pickford, of Wood-Street, in the city of London, Common Carrier; and James Whitbourn, of Goswell-Street, in the said county, Coach-Smith; for certain improvements in the construction of the Wheels of all Wheeled-Carriages, and of all other vertical Wheels of a certain size. Dated Sept. 27, 1822.—In two months.

To James Frost, of Finchley, in the county of Middlesex, for a new method of casting or constructing Foundations, Piers, Walls, Ceilings, Arches, Columns, Pilasters, Mouldings, and other Enrichments to Buildings. Dated Sept. 27, 1822.—In two months.

To Samuel Pratt, of Bond-Street, in the county of Middlesex, Trunk and Camp-Equipage Manufacturer; for certain improved Straps or Bands, to be used for securing Luggage upon Chaises or Coaches, or for securing property generally, when placed in exposed situations. Dated Sept. 27, 1822.—In six months.

To Thomas Binns, and Jonas Binns, both of Tottenham-Court Road, in the county of Middlesex, Engineers; for certain improvements in propelling Vessels, and in the construction of Steam-Engines and Boilers, applicable to pro-

pelling Vessels, and other purposes. Dated Oct. 18, 1822. —In six months.

To William Jones, of the parish of Bedwellty, in the county of Monmouth, Engineer; for certain improvements in the manufacturing of Iron. Dated Oct. 18, 1822.—In two months.

To Stephen Wilson, of Streatham, in the county of Surrey; for a new Manufacture of Worsted. Dated Oct. 18, 1822.—In two months.

To Samuel Francis Somes, of Broad-Street, Ratcliffe, in the county of Middlesex, Ship-owner; for an improvement in the construction of Anchors. Dated Oct. 18, 1822.—In six months.

To Uriah Lane the younger, of Lamb's Conduit-Street, in the united parishes of Saint Andrew Holborn, and Saint George the Martyr, in the county of Middlesex, Straw-Hat Manufacturer; for his improvement in the Platting of Straw, and in manufacturing Bonnets and other articles therefrom. Dated Oct. 18, 1822.—In two months.

To John Williams, of Cornhill, in the city of London, Stationer; for a method to prevent the frequent removal of the Pavement and Carriage Paths, for laying down and taking up Pipes, and for other purposes, in Streets, Roads, and Public Ways. Dated Oct. 18, 1822.—In two months.

To Joseph Brindley, of Frinsbury, near Rochester, in the county of Kent, Ship-builder; for certain improvements in the construction and building of Ships, Boats, Barges, and other Vessels for Navigation. Dated Oct. 18, 1822.—In six months.

THE

TECHNICAL REPOSITORY.

XCII.—*On an Improved Physeter or Percolater, and other Filtering Apparatus; and also on a Drying Stove, and on a Compound Press, used for making Madder and other coloured Lakes. By Mr.* GEORGE FIELD. *With Remarks by the* EDITOR.

[Concluded from p. 348.]

WITH TWO PLATES.

OF A COMPOUND PRESS.

I HAVE now to submit to the judgment of the Society, the following Compound Press, contrived for the double purpose of pressing by weight and power.

Pressure is a mechanical subject of no mean extent and application, both nature and art effecting many important operations by its means. These means are either active, passive, or compound. Active, is the application of the mechanical powers; passive, by weight; and compound, when both these are united.

The principal and superior advantages of *pressure by weight*, are, that it is equable, and continues without attendance. Its disadvantages are, that its force is comparatively small; and that the power required to manage it, is equal to that which it exerts in pressing, while its comparative bulk is excessive. The principal and superior advantages and disadvantages of *pressure by power*, are exactly the reverse of those *by weight*;—strong, but not continuing; easily manageable, but requiring attendance; and of little comparative bulk. The design in the present invention is, to unite these advantages; and to correct the disadvantages by opposing them.

Plate XV. fig. 5, is a compound press, for extracting tinctures, &c.; *b*, the screw; *m*, a hard bell-metal socket (represented in section), on which the nose of the screw acts, when pressed down. This socket is fixed fast to the play-board, and contains oil within it. *n*, *n*, the sides of a cast-iron rim, surrounding the play-board, and forming a box, to contain two, four, or more, square cast-iron half-hundred weights, to load the press with occasionally. *o*, a bridge, or staple, through which the cylindrical end of the screw passes; and is kept from rising entirely out of it, by a collar fixed on its nose by means of a pin passing through it. This bridge allows the loaded play-board to descend without impediment from the screw, and thus keeps up a constant pressure on the substance to be pressed, and which is contained in a bag, *q*, &c. This pressure can be increased or diminished at pleasure, by putting more or fewer weights in the box; and finally, the power of the screw itself can be exercised, either to get out the remaining dregs, or to raise the box and weights up again.

Fig. 6, an end view of the press; *p*, *p*, two, of four rollers, to guide the play-board of the press.

I have the honour to be, with great respect, Sir,

Your obliged humble Servant,

Hounslow, March 20, 1815. G. FIELD.

To C. Taylor, M.D. Sec.

REMARKS BY THE EDITOR,

Having formed part of the committee which went to Mr. Field's to inspect his apparatus, we cannot omit this opportunity of expressing the high gratification we experienced from the sight of it; and also in the great ingenuity he had displayed, in converting, what had been originally a two-stalled stable, and the loft over it, into a commodious manufactory for colour-making: and we feel great pleasure in subjoining the following additional particulars for the information of our readers.

The *Physeter* was placed on the ground-floor, and over it was fixed a large tub, the top of which was even with the floor of the loft above, and had a cover to shut over it, when not required to be open, and thus formed part of the floor of the loft. In the loft was another tub or water vessel, let through, and resting upon the wall of the loft, into which the water was raised, by a lifting and forcing pump, from the well. This pump was placed on the ground-floor, and—in order to inform the person who worked it, and also persons in the loft above, of the depth of the water in the tub—a cork bung floated on the water, from which a line passed over two pulleys, and descended to the ground-floor; on this line two beads were tied; and against the walls of both rooms, similarly graduated scales, drawn upon paper, being fixed—the beads indicated the depth of water in the tub. In the bottom of the tub over the physeter, a conical plug or valve was placed, which could at any time be opened, to permit the contents of the tub to flow into the physeter, and be closed again.

Pipes, with cocks to them, supplied this tub, either with water from the reservoir, or with coloured liquids from a square copper boiler set in brick-work, erected in the loft, as the process required.

The Drying Stove was also situated in the loft, by the side of the boiler.

The Compound Press stood on the ground-floor.

Besides the articles enumerated, the upper room also contained a Steel Mill, for grinding those colouring drugs which Mr. Field could not obtain ready ground; nests of shelves, with bottles properly labeled, containing chemical tests, &c.; tables; a chemical stand, for operating with a lamp; supports against the walls for filters; other filters upon moveable stands; &c. &c.

The madder lake, in the state in which it was filtered, was in the form of a pulp, from which it was exceedingly difficult to extract the water by the ordinary means: and here the physeter was of most essential benefit; as when the

pressure of the atmosphere was induced upon the filter, by removing the air and water from beneath it with the pump, the water in great part was extricated immediately; the lake was then taken off the filter by means of a porcelain spoon, put into the tinned copper or iron trays, and dried in the stove.

It will be seen, from the above statement, that no use was here made of the numerous chalk stones usually employed by the colour-makers to dry their colours upon, they being entirely superseded by the employment of the physeter and air-stove; and, indeed, Mr. Field merely used one in the loft, for trying small experiments upon, and to save him the trouble of going below to the physeter.

The silk strainer of the physeter was readily cleaned at any time, by merely washing it with a wet sponge; and when it happened that a small hole might be made in it, he readily closed it, by dropping melted sealing-wax upon it.

Mr. Field preferred the employment of silk lutestring for filtering in general, to that of any other material, as paper, &c.; for, when most of the water was drained off, he could wring the precipitate nearly dry,—a thing totally impossible in using paper: it is also exceedingly durable, and easily freed from colouring matters, by rinsing with water. When, however, he had occasion to filter caustic lie, which would have acted upon the silk, he employed filters of linen or cotton cloth.

Immediately after the description of the physeter appeared in the Society's volume of Transactions, a patent was taken out, to endeavour to secure its application to the extracting of molasses from sugar.

XCIII.—*On Grinding and Polishing Lenses, for Optical Purposes. By the* EDITOR.

FOR the knowledge of the following valuable manipulations, we are indebted to an old and experienced workman, formerly in the employ of the celebrated Mr. Tully, of Islington.

OF THE GUAGES FOR CONVEX AND CONCAVE GRINDING-TOOLS.

The mode of forming these is truly ingenious. A glazier's diamond being fixed near one end of a bar of wood, in the proper situation for cutting; holes are made through the bar at proper distances, according to the lengths of the foci of the intended lenses; and a piece of crown window-glass, being secured firmly upon a table or work-bench, a brad-awl is passed through one of the holes in the bar, and affixed in the table, as a centre; and the piece of glass is then cut through with the diamond, thus forming correspondent convex and concave guages at once. The edges of these guages are then rubbed or ground against each other in the following manner. One of them being securely held upon a table which is wetted with a mixture of emery and water, the other is rubbed against it, continually changing their sides and ends, until the curves are perfected. The workmen generally prefer, for this purpose, those pieces of crown glass which have upon them, parts of the smooth rounded edges of the semi-circular plates of glass.

OF THE PATTERNS FOR CASTING THE GRINDING-TOOLS FROM.

A convex and concave pattern is turned in well-seasoned wood, to the exact curves of the guages, of a proper thickness for the tools, and having short cylindrical stems at their backs, with screwed holes in them, to fit upon the screwed arbor or mandrel of the lathe.

OF THE GRINDING-TOOLS.

From each of these patterns, a cast-iron and a brass tool must be formed; and screwed holes being made at their backs, to fit upon the lathe mandrel, their surfaces must be carefully turned to the guages. In order to remove the marks of the turning tools, pieces of old broken flat files are laid in or upon one of the surfaces; the backs of the pieces of files having previously been coated with a sufficient thickness of the cement to be afterwards described; the other corresponding convex or concave grinding-tool,

must then be heated over a fire, until it will cause water dropped upon it, to hiss or form air-bubbles; when it is to be applied to the cement on the pieces of files, and be immediately cooled, by wiping its back all over with a sponge wetted with water. The pieces of files are then to be worked or rubbed over every part of the turned surfaces, to bring them nearer to truth; and finally, blocks of lenses must be ground in them, to perfect them, in the manner to be hereafter described.

TO PREPARE THE GLASSES FOR GRINDING.

These must be chosen of the proper thickness and quality of glass, as free as possible from veins or blebs; and be clipped (or *nibbled*, as the operation is termed,) by means of well-known iron instruments, into equally-sized circular pieces. Seven of these are usually ground at once; viz. one in the middle, and the others surrounding it. Before finishing them in the brass tools, however, they are rough-ground on the cast-iron tools singly; in order to which, their backs are coated with cement, to a sufficient thickness to form handles to hold them by, by pouring the melted cement from an iron ladle upon them in succession, as much at a time as will conveniently lie upon them without running off, and renewing these coats till the required thickness is obtained.

These are then worked in or upon the cast-iron tools, with the assistance of that kind of emery termed by the makers, No. 2, *corn emery*, and water, until their surfaces shall have become nearly convex or concave; the tool being placed in a shallow wooden trough, to catch and retain the emery, which is afterwards washed over, (in the manner to be described,) to finish the grinding.

OF THE CEMENT FOR FIXING THE GLASSES ON THE GRINDING-TOOLS.

This cement is made of common pitch and sifted wood-ashes from the biscuit-bakers, melted together in proper proportions to give it a due consistence, according to the temperature of the weather.

ON FINISHING THE GRINDING OF THE LENSES.

The rough-ground glasses being placed in the manner above described—with their faces in or upon the surface of one of the brass grinding-tools (the cement on their backs having, however, been previously reduced to an exact thickness, and flattened, by the application of a heated flat-iron to each, singly)—one of the cast-iron tools is heated in the manner before mentioned, applied to the cement on the backs of the lenses, and instantly cooled, as above directed. Great care must be taken, in placing the seven glasses in or upon the brass tool, to fix the best piece of glass in the centre, as that will form the most perfect lens; and also to see that no two of the other glasses are in contact, but are a little removed from each other. They are now ready for finishing the grinding.

ON THE PREPARATION OF THE EMERY, BY WASHING OVER.

The emery used for rough grinding in the cast-iron tools, is washed over, so as to separate it into six different degrees of fineness, in the following manner:—

It is put into a large earthen-ware vessel, which is nearly filled with water, and being stirred up, is left to repose for the space of one quarter of a minute, and is then poured off into another large vessel; and so on, in succession, according to the following periods, viz.:—

No. 1. One quarter of a minute.
2. One minute.
3. Two minutes.
4. Six minutes.
5. Fifteen minutes.
6. Thirty minutes.

After having stood the proper time for each degree, the emery deposited in the large vessels is put into small earthen vessels, which are carefully covered over with paper caps, to guard against the entrance of dust; and are marked No. 1 to 6.

OF THE STAND AND HANDLE FOR THE GRINDING-TOOLS.

A well-framed stand, of a proper height, and not too wide at its base, must be provided. This is to be firmly screwed to the floor of the work-shop. On its top a cast-iron block is to be affixed, having upon it a male screw, exactly similar to that upon the end of the lathe mandrel; and upon this, the female screw at the back of the brass tool is to be screwed. Into the female screw at the back of the cast-iron tool, a handle, made of *lignum vitæ* or other hard wood—of the form of a bulb, or an oblate spheroid, of a convenient size to be readily grasped with the hand, and having a male-screw made to fit—is to be put. The tools will now be ready for work; and the operation must be performed in the following manner:—

ON THE MANNER OF GRINDING IN THE TOOLS.

A little of the washed emery No. 1, mixed with water to a thick consistence, is to be taken out of the vessel with the fingers, and to be spread pretty uniformly over the surface of the brass grinding-tool. In order, however, still more to equalize it, and prevent it from lodging in lumps, a piece of glass which had been previously ground, of the same curvature as the tool, is to be worked in it; and the outer edge of the tool is also to be freed from the emery with a wet sponge. The block of lenses is then to be placed in or upon the brass tool, and the grinding proceeded with as follows.—The workman takes hold of the handle of the block with his right hand, and gives it a long oval movement across the tool, carrying it a little beyond its edge; and, every second stroke, giving the block a twist with his left hand; at the same time gradually walking round the stand, backwards and forwards alternately, so as to give every part of the tool an equal chance of wear. In case the block moves too stiffly, a little water should be sprinkled over the surface of the tool; and as soon as the emery is clogged with the glass, and ceases to cut, it must be wiped off, with the moistened sponge, both from the tool and the lenses; carefully observing that none is suffered to

lodge in the spaces between the lenses. The next degree of the emery is then applied in the same manner; and so on, till each has done its office. No. 6, however, is to be applied twice, in order to bring the lenses to a better and finer surface for polishing. If, however, during the operation, any scratches are found to appear on the lenses, even when viewed with a magnifier, the operation of grinding must be repeated. Great care ought also to be taken to wash the sponge clean from the different sorts of emery during the process.

TO POLISH THE LENSES.

A tool is to be heated and coated with cement; and for large lenses it must be lined with a thick woollen cloth, made on purpose; for smaller ones, with ordinary woollen cloth; and for still smaller, with kerseymere: either of these, as the case may require, is to be applied upon the heated cement, and then be worked in or upon the lenses affixed to the block, till it has assumed their curvature. The pores of the cloth are then to be filled up with No. 6, washed emery and water (or the finest sediment which will in time be formed in the tub, in which the sponge, after wiping the grinding-tools, is continually washed), to bring it to an uniform surface; and when cooled, putty or the combined oxides of tin and lead is shook uniformly over it, from a tin box with a lid perforated with holes, and a little water is sprinkled upon it. The polishing then commences:—but the strokes are now made backwards and forwards directly across the tool, not in oval sweeps as before; and the other directions must be particularly attended to.

When both sides of the lenses have been ground and polished, in the manner described, they must be finished separately. This is termed *rectifying* them.

ON RECTIFYING THE LENSES.

In order to perform this operation, SMALL TOOLS must be cast of the following compound metal, viz.

Lead, one pound;
Regulus of antimony, eight ounces.

This composition admits of being readily turned in the lathe, with tools wetted with water.

In order to form the tools, a hole must be turned in a piece of wood, to the shape the tool is to be made of; namely, with a round flat surface, large enough to hold the lens when cemented upon it, and with a stem at the back, to contain a female screw, which is to be cast in them thus. The mandrel of the lathe is to be placed in the middle of the hole made in the piece of wood, and the melted compound metal must be poured into the mould thus formed. When cold, the tool is to be finished in the lathe by turning it, and its flat face must be roughened by making scratches across it in every direction, the better to retain the cement upon it.

OF THE CEMENT FOR RECTIFYING THE LENSES.

Pitch, one pound;
Bees-wax, one ounce;

melted together, and strained through a cloth.

Two of these tools, being coated with this cement whilst it is warm, are to be applied successively to the wetted surfaces of the lens, so as to take its curvature or curvatures exactly: the cement must, however, previously have two gaps or furrows made through it, to the surface of the metal tool; and these must again be crossed by two others, for the extraneous polishing material to lodge on.

The lens will readily adhere to either of the surfaces formed of the cement, by merely breathing upon it, and can easily be removed again; which is absolutely necessary in this operation of rectifying it.

The polishing or rectifying is effected with the finest washed putty, applied upon one of the faces formed of the cement, whilst the lens is held upon the other: and the putty is put into a phial with water; and only that which remains suspended in the water, after being stirred up, is employed.

ON CENTERING THE LENSES.

This is effected by affixing the lens upon the end of the hollow mandrel of a lathe, coated with a ring of cement, whilst it is warm; and an object being placed before the lens, and a proper sight-hole provided at the opposite end of the mandrel, the mandrel is to be turned slowly round, and the lens shifted until the object appears steady when viewed through it. When the cement is cold, the lens is to be turned circular in the lathe, by applying a cutting diamond to it.

XCIV.—"Assainissement;" *or, Modes suggested for the Preservation of Health, by Ventilation, &c.**

WITH A FIGURE.

THE most ancient observations have demonstrated the great influence which different situations have upon the health of individuals in all classes. Their habits having removed them farther from the simple tastes of nature, have augmented the causes of malady, and which have increased in proportion to the progress of civilization. These results are more sensibly experienced amongst the labouring classes; and especially those artisans who are engaged in one particular manipulation†; and who appear to have formed a determination to renounce all means of safety, and to have employed all their faculties in drawing upon themselves one common destruction. To this general cause of unhealthiness may be added divers others, peculiar to each profession.

We may place in the first rank, amongst the latter, the insalubrity of the air in the workshops, caused by too great a degree either of humidity or dryness, or by noxious exhalations introduced into the animal economy by respiration. The workmen falling a prey to these unhealthy emanations, are marked during their whole lives by a physiognomy of

* From the *Dictionnaire Technologique*. † Water-gilding.

suffering particularly remarkable; and which indicates an internal and continually progressive change, produced by these deleterious substances. Thus, for example, in all those arts or trades where lead, copper, mercury, &c. are used, the individuals employed therein have a livid pale complexion, and are generally thin and melancholy. Amongst the latter, very few escape the *mercurial tremor;* a frightful malady, of which we shall hereafter speak. It is impossible to suppress a most painful feeling, when we see certain persons, who, by habit or circumstances are attached to such pernicious professions, so heedlessly enduring those evils which they seem to have given themselves up to; and which, indeed, are of their own creation;—they firmly attach themselves to them, notwithstanding that the result is always to shorten the term of their existence. It must surely proceed from a very great degree of insensibility, that persons should persevere in these prejudices, after having witnessed the painful and mortal diseases which the greater part of these arts and trades yearly send to the hospitals. But this insensibility appears still more singular, when we find that the individuals already attacked, still continue to expose themselves to these dangerous influences.

We have then much to combat against, in the application of the most sure and simple means of preserving health, with which we have for many ages past been furnished by scientific observations: yet, however, it must be acknowledged, that our ideas in this respect were far from being fixed in so positive a manner, as they have been for some few years past, by a work which we are here called upon to analyse, and which now completes a general system, which may be termed *Assainissement*, or the Art of Preserving Health.

We shall have occasion to shew, that medical observations on the exterior causes of maladies,—such as the influences of the atmosphere, in its various hygrometric states; of deleterious gases; the emanations from certain

bodies, &c.—have been made from time immemorial. We shall also see, that Chemistry and Philosophy have lately thrown much light upon these observations, and have pointed out the means of preventing such distressing results. All the efforts, therefore, which remain to be made, now that the problem is solved, should be directed against the apathy evinced by some, and the opposition created by others. The *hygeianic* means, ingenious and simple, which have been published since the year 1715, have been wholly neglected, or successively repulsed by inconsiderate oppositions. The history of the first attempts at *assainissement* presents a multitude of interesting facts. We shall here give an abridgment of them, and a public acknowledgment to those men to whom we are so much indebted for their scientific observations.

It is, however, very important to place these observations in chronological order; as certain authors, who have merely renewed them, with some little alterations, have endeavoured to publish them as their own inventions. The traditions with which we are furnished, allow us to trace these observations as far back as to Hippocrates, a celebrated physician, born more than 2000 years since. He attributed to the air the greatest influence on the physical state of our bodies: "*Aër est omnium rex morborumque causa.*"

This profound observer had also remarked, that all maladies might derive their origin from considerable differences in the temperature or in the hygrometric state of the atmosphere. He explains it thus: "*A calido supramodum calefaciente, a frigido supramodum refrigerante, a sicco plus æquo resiccante, et humido etiam plus æquo humectante.*"

He mentioned facts, which numberless later observations have confirmed, and which prove how many maladies are caused and cured by the different states of the atmosphere.

He cites, amongst other things, a great number of epidemic maladies, which were all preceded by remarkable

changes in the atmosphere, the seasons, &c. And he was led to advise, that, at a time when any dreadful malady attacked a city, it might be freed from it by driving off the morbific air, by means of large fires.

In 1521, Agricola conceived the idea of improving the art of working of mines, which was then in a state of complete barbarism, on account of the dangers resulting from the emanations of the deleterious gases. He thought of producing a current of air, by the aid of fire. This was the first attempt at ventilating mines, and is the origin of ventilation in general. It was published in 1550, in his work on Docimastery.

In 1614, Keslar, a painter of Frankfort, published the invention of the Italian stoves of various constructions; and which indicated a knowledge of the circulation of air occasioned by heat.

In 1669, Glauber thought of making the air circulate on the exterior of heated tubes, and constructed furnaces, whose combustion was supported by currents of air brought from caves and wells.

In 1715, the Cardinal de Polignac (*Percy et Laurent, Dictionnaire des Sciences Medicales*, Art. VENTILATION) under the name of Gaugé, gave a Treatise to the public, entitled "*Mechanique du Feu*," demonstrating most of the principles on which are founded the construction of caloriferes and ventilators, and in which he made many ingenious applications*.

* He proved the ascending movement of the air, occasioned by its rarefaction, which renders it lighter in the same volume; the variations of the thermometer, in different places and heights in the same chamber; and the means of correcting and avoiding the cold draughts of air from doors and windows, by giving the air a proper access; and keeping the chambers (of sick people especially) at an equal temperature of any degree required.

He has given means of measuring the force of the air, and consequently of ascertaining the quantity entering by any given opening, and in any determined time. In fact, it must be remarked, that in this very interesting work, are contained the principles and the first ideas of every invention made since his time. One may better judge by the conclusions at the end of his work, of which we here give an extract.

1st.

He laments, that the persons charged with the care of these inventions, either refused to make use of the very simple means of preserving health which he had pointed out; or, if they did consent to use them, in consequence of their being so badly executed, their intended effects were totally destroyed. We shall have occasion to mention in the latter part of this article, that D'Arcet, notwithstanding all the proofs he afforded of his numerous successes, met with the same hindrances in the complete application of his theory.

In 1715 (in the same year), Desaguliers published, in England, a translation of Gaugé's work, with the additional information that pit-coal might be substituted in place of

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1st. The fire is lighted quickly, without blowing, or small wood.

2d. The fuel is more economized, and the heat may be communicated to the various apartments.

3d. The desired temperature may be obtained almost instantaneously, and without modifying the fire.

4th. The division of the heat is very equal.

5th. The exterior air can no longer rush in by the chinks of the windows or doors, nor form cold draughts.

6th. The hot air is diffused to a great distance from the fire.

7th. By means of the circulation of hot air, a bed, &c. may be warmed.

8th. The air which is respired is continually removed, and fresh air is incessantly breathed, and at whatever degree of temperature is required.

9th. Humid air may in a very short time be driven away, and be entirely replaced by dry air.

10th. The furniture is preserved from humidity, and the health is less subjected to alteration.

11th. The warmth may be preserved during the night after the fire is extinguished.

12th. There is nothing to fear from smoke or its unpleasant effects.

13th. The fire may be extinguished in an instant, if likely to set fire to the chimney.

14th. The channels for the smoke cannot possibly communicate it from one chamber to another.

15th. These principles may be applied in various ways to the operations of chemistry.

16th. By means of particular screens, we may see the fire, without scorching the eyes.

17th. We see here the mechanism of perpetual bellows.

wood, with advantage; and afterwards made several curious experiments, which completely overturned many deeply-rooted prejudices, by shewing that the air, after having been heated to a red heat in an iron pipe, was, on cooling, as proper for respiration as ever.

In 1720, he invented (in consequence of some hints derived from a workman) a method of drying and preserving malt, by means of currents of hot air.

In 1723, he made an useful application of one of Gangé's inventions, in purifying the air of the House of Commons during its sittings, and which had been rendered very impure, owing to the great number of Members assembling, and the numerous candles employed in lighting it*.

In the year 1723, the detail of some experiments, made to expel the bad air from mines, and to introduce respirable air in its place, by means of pumps, was published in the *Transactions of the Royal Society of London*, No. 400.

In 1736, Desaguliers substituted, in the House of Commons,—in place of the apparatus which he had made use of in 1723, and which had not been used for a long time,—a centrifugal wheel, on the principle of Hesse, and Papine's bellows; and the effects of which were exactly the same.

This machine extracted the vitiated air from any room, and introduced the external air in place thereof. It was worked by a man, and was called a *Ventilator*. This man regulated it as required by the Speaker, to renew the air when necessary.

In 1739, Sutton conceived the idea of renewing the air in the holds and between the decks of ships. The observation which gave rise to this project is rather curious, and

* The success of this happy expedient, however, was rendered of short duration, by the conduct of the porter's daughter, to whom these new arrangements gave some trouble, who completely baffled the enterprize, by lighting the fire of the ventilator, which was entrusted to her care, at an improper time.

may be interesting. He remarked, that in a room which had three chimneys, on the doors being shut, and fires lighted in two of them, the air rushed into the room with great violence by the third chimney; but that when fires were lighted in all the three chimneys, the external air was attracted with such force, that very heavy doors were opened with great violence by its action.

In the execution of the project which Sutton had conceived, he met with great and inconceivable opposition, principally from the Admiralty, and those officers of the Navy who were so much interested in restoring salubrity to the lower parts of vessels, from whence the germs of so many maladies originated.

He at length addressed himself to Dr. Mead, who, attributing the origin of most diseases, and amongst others the scurvy, to impurities in the air, comprehended immediately the measures recommended by Sutton; and by the advice of this distinguished physician, experiments were publicly made of them.

In 1741, these experiments having completely succeeded; his Majesty ordered that all vessels belonging to the Navy should be provided with ventilators.

Sutton's process consisted in making the air, which supplied the draught of the fire employed for the ordinary uses of the ship's crew, proceed through tubes, the extremities of which opened either into the holds, between decks, or into any other part, from whence it was thought necessary to extract the impure air, and replace it by fresh.

Sutton complained that Hales, knowing of these means, had not mentioned them. He made the following comparisons between his machine, actuated by fire, and the Lever-ventilator of the latter:

"Hales's machine requires labour to work it, as it is put in motion by men; the effects of this machine are interrupted, and it takes up considerable room.—The fire-machine costs nothing in working, as it is acted upon by

the fire requisite for the use of the vessel; the effects of this machine are constant; and, finally, the tubes are easily fixed, and require but little room."

Another machine was also projected in Sutton's time, to ventilate the lower decks and holds of ships. This machine is composed of a large conical wrought-iron tube, open at both ends; but the upper part of it was formed upon a plan so as to taper from the largest part of the cone, at an angle of 45°. (If this description is not well understood, the form of the tube may be easily conceived by comparing it to a very long trumpet.) This tube is fastened to the mast, and is thus supported in a vertical position—its lower part is fixed to the deck, and communicates by tubes between decks to the hold. The sails were so managed as to be brought near to the upper and largest part of the cone, and so as to reflect the wind from whatever quarter it might blow to this opening. It was supposed that the air thus driven from the top of the tube to the bottom, blew with more or less strength into that part of the vessel they wished to ventilate. All this apparatus, difficult to erect, having very irregular effects, and sometimes even becoming useless, when the ship was becalmed—which is, indeed, when the renewal of the air in the different parts of the vessel is most necessary;—all this apparatus, I say, was worth nothing, and unjustly prevented the adoption of Sutton's apparatus, from which was derived this idea of *sail ventilating*, in the hope of dispensing with the ventilator of the latter. But a short experience of these imperfect means did ample justice to his invention.

In 1753, Sutton's fire machine was established in the coal-mines of Balleroi, in Normandy, with great success.

In 1740, Hales published an excellent memoir on various *hygeianic* means, which he proposed for the equipment of vessels; and among which, the most important were, different modes which he suggested of ventilation, by means of very ingenious bellows.

It is to him we owe the first idea of drying gun-powder

by means of currents of dry air*. He applied the same methods to the drying of hops, cloth, feathers, corn, &c. to preserve these substances. It was also used for ventilating, airing, cooling, warming, or preserving dry, warehouses, hospitals, chambers, dove-houses, &c.; to destroy rats and mice, &c. by blowing into the parts infested by these animals, sulphurous acid for a time, thereby forming an irrespirable atmosphere. The same ventilator will afterwards introduce the external air, which will in a few minutes entirely drive away the sulphurous vapour. He used the same means to sweeten the holds of ships, or rooms which might be infected by certain diseases, filling them with various vapours; such as those of aromatic vinegar, essential oils, &c. and renewing the air frequently.

These various means were used with much success in the prisons of Porchester Castle, Winchester, and Newgate; in St. George's Hospital, those of Northampton, and Bristol; and also in the Small-Pox Hospital.

I shall now give a description of Hales's bellows, and their effects.

His centrifugal bellows are now too well known to render it necessary to give a long description of them here. Suffice it to say, that this machine is very simple in its construction, and convenient for use. The air is attracted by the rotation of many planes turning on the same axis, and is driven, by means of the centrifugal force exerted by these plane surfaces, from the centre towards the circumference of the machine. It is easy to conceive that the air is powerfully attracted towards the openings formed near to the axis, and that it is discharged with considerable force through the tube adapted to the circumference of the machine. We may then, by means of pipes applied to this machine, extract the air from any place, and force a current of external air into it. If to the centre of this ventilator, a tube is adapted which communicates with a vessel filled

* The Baron Champy has in our times revived the use of this invention.

with any gas at pleasure: on working the machine, this gas is conveyed, by the tube of emission, into whatever place it is intended to be introduced.

He has likewise described the construction of a rectangular, and partly cylindrical bellows. Those which he most generally employed in ventilating on a large scale, were made double, for the purpose of producing a continued effect, by their alternate action, (each part was made alike, and of the same dimensions, viz. 54 inches long, 12 inches wide, and 20 inches high), and was formed of a rectangular coffer, A, B, C, D, E, F, (see fig. 1, Plate XVI.) separated into two equal spaces by a diaphragm, (or a plane, parallel to the two other higher and lower planes, A, B, C, and D, E, F), moveable on an interior axis, M, N, from A to D, as indicated by the dotted lines, A, M, and D, M; and describing in its course the segment, A, P, D. This circular part determines the form of the side (or bottom of the coffer), A, O, D. We may imagine this form to be that of part of a cylinder, of which M, N, is the axis; a rod, R, O, passes through the upper part of the coffer, A, O, D, C; one end of which, K, is fixed to the diaphragm by a pivot, and the other is attached to a lever, to which is given a vertical alternating motion; and thereby the diaphragm is elevated and depressed. At every movement impressed on the diaphragm by the rod, O, R, is effected a simultaneous aspiration of air by one valve, and an emission of it by the other. Thus, supposing the diaphragm, when in the position indicated by the dotted line, A, M, to be lowered to, B, M; by this movement, all the air contained in the space, A, D, M, will escape by the valve, 1, and an equal quantity will enter by the other valve, 3. If then, the diaphragm is again raised, we may conceive that the contrary effects will take place; the air contained in the upper space, D, A, M, B, will be impelled outwardly, through the valve, 2; and at the same time, the space, A, D, E, M, will fill afresh by the valve 4: and the same effect will take place at every movement of the diaphragm.

These bellows are constructed of wood, without any leather; their movement is simple, and they are not likely to get out of repair.

According to the dimensions before stated, every movement of the diaphragm affords 7 cubic feet of air; two men will make 60 strokes per minute, $7 \times 60 = 420 \times 60 = 25{,}200$: this produces, as we see, more than 25,000 cubic feet per hour. We may, by calculating the quantity of air proposed to be entirely renewed in any given time, determine the dimensions of these double coffers to obtain greater or lesser results accordingly.

Hales's treatise contains a great number of important observations relative to many of the causes which influence the health of seafaring men: he points out also, precautions essentially necessary to be taken, to prevent those maladies which frequently display themselves in ships.

(*To be continued.*)

XCV.—*On the Use of the Blow-Pipe in Chemical Analysis, and in the Examination of Minerals.* *By* J. J. BERZELIUS. *Translated from the French of* M. FRESNEL, *by* J. G. CHILDREN.

[Continued from p. 324.]

OF THE REAGENTS AND THEIR USE.

"CRONSTEDT commonly employed only three Reagents—sub-carbonate of soda, borate of soda, and the double salt formed of phosphate of soda and phosphate of ammonia. I shall henceforth, for the sake of brevity, call these simply soda, borax, and salt of phosphorus.

"These reagents are still employed; and in the multitude of substances which have been tried since the time of Cronstedt, there is not one preferable to either of the above, in their respective uses. It is singular, that in the infancy of the art, the best should have been hit upon. To these, which are the principal, and always in request, others have since been added,—not so frequently wanted indeed, but

which it is necessary to have at hand for particular cases. I shall treat in succession, of the different salts employed, and explain the object to which each is applicable, and the method of using it.

"1. *Soda.*—(Carbonate of soda). We may take indifferently, either the carbonate or the bicarbonate; but both must be perfectly pure, and especially free from sulphuric acid. The best method of obtaining the bicarbonate is, to impregnate a concentrated solution of purified soda, such as is found at the druggists, with carbonic acid gas. In this operation the bicarbonate precipitates in the form of small crystallized grains, which are to be twice washed in cold water and dried. The salt, either previously ignited or not, is reduced to fine powder. If not ignited, it is more bulky; but there is this inconvenience from igniting it, that if the knife with which we take up small portions of it be wet, the moisture gradually communicates to the whole mass, and causes it to collect into coarse lumps.

"Two principal objects are connected with the use of soda; 1st, to ascertain if bodies combined with it be fusible or infusible; 2dly, to assist the reduction of metallic oxides. In both these respects it is one of the most indispensable reagents.

"(*a*) *Of the fusion of bodies by soda.*—A very large number of bodies have, indeed, the property of combining with soda at a high temperature; but most of these combinations are infusible. It is only with acids and a small number of metallic oxides, including silica, that it forms fusible compounds, which for the most part are absorbed by the charcoal.

"Of these compounds, the glass formed with silica, or siliceous minerals, occurs most frequently. With regard to the use of soda, many minutiæ are to be observed. We take up the necessary quantity with the point of a small knife, previously moistened by the mouth to make the powder adhere to it. It is then applied to the palm of the left hand, and if necessary, moistened again, so as to form

it into a coherent mass. If the substance to be tried be pulverulent, it must be kneaded in the hand with the soda; but if it be in the form of a spangle or grain, the soda is applied to its surface; it is then heated on charcoal, at first to dryness, and afterwards till it fuses. It commonly happens, that the soda is absorbed by the charcoal the instant after it is melted; but this does not prevent its effect on the assay: for if it be fusible with the soda, it soon after *pumps* it up again (*la repompe*), a continued effervescence appears at its surface, its edges become round, and the whole is transformed into a fluid glass globule. If the assay be infusible in soda, but decomposable by it, it is perceived to swell up by degrees, and change its appearance without fusing. Ere we pronounce on the infusibility of any substance with soda before the blow-pipe, we must try a mixture of the flux with the substance *reduced to powder*. If we take too little soda, a part of the matter remains solid, and the rest forms a transparent vitreous covering around it; if we take too much, the glass globule becomes opaque on cooling.

"The assay may perhaps contain some substance, which, being infusible in the glass of soda, destroys its transparency. In that event, to avoid being deceived with respect to the nature of the glass, we must, in the two before-mentioned cases, add a fresh portion of the matter supposed to be wanting, and thus endeavour to obtain a clear glass globule. In general, it is best to employ the soda in small successive doses, observing the changes produced by the different proportions of the flux. It sometimes happens, that the glass becomes coloured at the moment it begins to cool, and ends by assuming a tinge, which may vary from yellow to deep hyacinth red; occasionally it even becomes opaque, and yellowish brown. These appearances occur, if the soda contain sulphuric acid or only sulphur, and the discoloration is the consequence of the hepar or liver of sulphur, formed by the reducing action of the charcoal. If it always ensue with the same soda, it is a proof that it

contains sulphate of soda, and must be rejected*, otherwise it is the assay which contains sulphur or sulphuric acid.

"Cronstedt and Bergman directed minerals to be fused with soda in a metal spoon, because they supposed the absorption of the soda by the charcoal would prevent its action on the assay. Gahn never employed a spoon in this case, for the fused mass spreads over metallic surfaces, whilst on charcoal it assumes a globular form, in which state we can more accurately judge of its colour and transparency.

"(*b*) *Reduction of metallic oxides.*—This mode of assaying, by which we often discover portions of reducible metal so minute as to escape detection by the best analyses made in the moist way, is, in my opinion, the most important discovery that Gahn ever made in the science of the blow-pipe.

"If we place a small piece of native or artificial oxide of tin on charcoal, a skilful operator will be able, with some exertion, to produce from it a small grain of metallic tin; but if a little soda be added, the reduction is easily effected, and so completely, that, if the oxide be pure, it is wholly converted into reguline tin. Soda, therefore, manifestly favours the reduction; but we are ignorant of its precise mode of action. When the soda surrounds the substance to be reduced, we may imagine that this reagent, which by its interposition between the assay and the charcoal prevents rather than facilitates their contact, may itself be reduced in a certain degree by the action of the blow-pipe; the consequence of which is the reduction of the oxide imbedded in the soda, by the base of the soda or its sub-oxide. If the metallic oxide contain a foreign body, incapable of being reduced, the reduction of the former often becomes more difficult in consequence; but if we add a little borax, this reagent will co-operate with the soda in dissolving the

* It is best to ascertain that the soda does not contain any sulphate before it is used. For this purpose, dissolve a small portion in distilled water; and, to the clear solution add a few drops of muriate of barytes. If the precipitate be not wholly soluble in muriatic acid, the soda contains some sulphate.—C.

foreign substance, and the reduction will be speedily effected. This experiment is easily performed, and the nature of the metal the more readily ascertained, from our generally knowing by previous trials, that of the oxide operated on; hence the reduction is only a confirmation of a previous conclusion.—Bergman has described this process.

"Suppose now, that the metallic oxide be mixed with a comparatively large quantity of irreducible substances, and that its presence be either unknown, or impossible to be ascertained by other similar experiments;—how are we to discover whether the assay contain a reducible metal; and if it does, how are we to prove it? Gahn has given a simple solution of this problem.

"The assay, being reduced to powder, is to be kneaded in the hollow of the left hand with moistened soda, the mixture placed on charcoal, and exposed to a good reducing heat; then a little more soda is to be added, and the blast renewed. As long as any particle of the assay remains on the surface of the charcoal, soda is to be added in small doses, and the blast continued till the whole mass is absorbed by the charcoal. The first portions of soda serve to collect the metallic particles, which were dispersed through the whole matter of the assay, and the final absorption of the latter completes the reduction of whatever till then had retained the state of oxide. This done, the charcoal is to be extinguished with two drops of water; and the portion containing the absorbed matter being removed with a knife, is to be reduced to very fine powder in an agate mortar. This powder is then to be washed with water, to free it from the charcoal which forms its lightest part; for which purpose we use the little *fountain of compression**. The grinding and washing, (the latter requires particular attention) are to be repeated as often as necessary, till the whole of the charcoal is got rid of. If the assay contained no metallic substance nothing remains in the mortar after the last washing. But if it contained any,

* See p. 823.

however small a portion of reducible metal, it will be found at the bottom of the mortar in the form of little brilliant leaves, if fusible and malleable; or as a powder, if brittle and not fused. In either case we perceive on the bottom of the mortar, metallic traces, arising from the friction of the particles of metal against the agate, provided the quantity of metal contained in the specimen was not too small. The flattening of malleable metals, transforms an imperceptible particle into a round shining disc of sensible diameter. Thus we may detect by the blow-pipe in an assay of the usual size, one-half per cent of tin, and even the slightest traces of copper.

"We must endeavour in these experiments, 1st, to produce as strong a heat as possible, by directing the reducing flame, so as completely to cover the surface of the fused mass; 2dly, to leave nothing in the charcoal, and to lose none of the assay when we collect it; for though the particles of the metal may be fused into a globule in some part of the mass, we know not where the globule is; 3dly, to grind the carbonaceous mass sufficiently; 4thly, to decant very gently, so that only the lightest and finest particles may be carried off by the water; 5thly, not to attempt to ascertain the result till the whole of the charcoal be got rid of; since the smallest remaining portion might be sufficient to conceal the little metallic spangles; and the particles of the charcoal themselves, seen in a certain light, display a metallic lustre, which may deceive an inexperienced eye: and lastly, we must not be content with examining the result with the naked eye, but inspect it carefully with the microscope; if it be only to satisfy ourselves that we have judged accurately concerning it. When the bottom of the mortar by long use has become uneven, the small cavities which it contains are sometimes filled with air, and form bubbles under water, whose convexity reflects light like a polished metallic surface. The nature of the reflecting surface is easily detected by turning the bottom of the mortar to the light; if it be a bubble, the light will be seen

through the spot it occupies; but if it be a spangle of metal, the spot will be opaque.

"The metals reducible by this process (besides the noble metals) are, molybdenum, tungsten, antimony, tellurium, bismuth, lead, copper, nickel, cobalt, and iron. Of these, antimony, bismuth, and tellurium, are easily volatilized by a strong reducing flame. Selenium, arsenic, cadmium, zinc, and mercury, volatilize so completely, that they cannot be collected without a little subliming apparatus.

"The reduction is always effected at the first trial, if the assay contain from 8 to 10 per cent of metal: but as its proportion diminishes, more attention and practice are necessary to keep it in the mortar, and ascertain its nature. A good method of practising oneself in this kind of operation, is to select a substance containing copper, and make several experiments of reduction with it, mixing it every time with a larger proportion of matter containing no copper; thus the metallic standard diminishes with every fresh experiment; and when we have arrived at such a proportion, that we cannot effect the reduction of the copper by a first operation, we must repeat the trial till we succeed in developing it. By exercising oneself in different trials of this kind, we soon become expert in such operations, which only require a little address and practice.

"If the assay contain several metals, the reduction of these oxides is commonly made *in globo*, and we obtain for our regulus a metallic alloy. A few reduce separately, as copper and iron, which give a regulus of each metal—copper and zinc; the former gives a regulus of copper, the latter sublimes. But when the result of the operation is an alloy, in order to find what metals it is composed of, we must have recourse to particular effects produced by other fluxes.

"For want of soda we may employ potassa in all the preceding instances; but soda is preferable, first, because its carbonate is not deliquescent like that of potassa; and, secondly, the capacity of saturation of soda is to that of potassa (all circumstances being equal) as 25,58 : 16,95, that is to say, in the ratio of the quantity of oxygen they contain.

"*2. Borax.*—The borax of commerce should be dissolved and crystallized afresh, before it is used for experiments with the blow-pipe. Gahn used often to remark, that in fusing borax of commerce with soda on charcoal, till the two salts are absorbed, a white metal is frequently obtained from the mass, which seems to be derived from the vessels in which the borax is refined. This does not happen with re-crystallized borax.

"The borax is kept either in small grains, of the size required for experiment, or in powder, in which case it is taken up like the soda, with the moistened point of the knife. Some operators fuse it, to get rid of its water of crystallization, and thus avoid the intumescence, which precedes the fusion of the crystal containing water, on the charcoal. This were a very good precaution, but that the borax soon recovers its water of crystallization, and swells up before the blow-pipe as at first, though in a rather less degree. I always use my borax uncalcined, for the intumescence is a slight inconvenience, and it is easy to melt the mass into a globule.

"Borax is used to effect the solution or fusion of a great number of substances. According as the matter to be dissolved is pulverulent or granular, it is spread over the borax at the instant of its swelling up, or fixed on the fused globule by being moistened. In general, we begin by attempting the solution of a *spangle*, because, if the assay be in the form of a *powder* in experiments of this kind, we cannot distinguish accurately the parts of the assay not attacked by the flux, from certain insoluble substances which may be present; and this distinction is often very important. We examine if the fusion of the bodies be effected slowly or readily; without any apparent motion, or with effervescence; if the glass resulting from the fusion be coloured, and if the colour be different with the oxidating flame, from what it is with the reducing; lastly, we observe if the colour increase or diminish by cooling, and if at the same time the glass preserve or lose its transparency.

"Certain bodies have the property of forming a clear glass with borax, which preserves its transparency after cooling,

but when slightly heated by the exterior flame of the lamp, becomes opaque, and turns milk-white, or is coloured, particularly if the flame has been directed on the glass in an unequal and intermitting manner. Such are alkaline earths, yttria, glucina, zircon, the oxides of cerium, columbium, titanium, &c. But one condition of this phenomenon is, that to a certain point, the glass be saturated with the oxide or the earth. The same thing does not happen with silica, alumina, the oxides of iron, manganese, &c. and the presence of silica is sufficient to prevent the appearance of the phenomenon with those earths, which form a glass with borax liable to become opaque, so that it does not ensue at all with their silicates, or only when the glass is supersaturated with them. To avoid prolixity, I shall say henceforth of a body presenting this phenomenon, that its glass becomes *opaque by flaming* (*au flamber*)*.

"3. *Salt of Phosphorus.*—To procure this salt, dissolve 16 parts of sal-ammoniac in a very small quantity of boiling water, and add 100 parts of crystallized phosphate of soda; liquefy the whole together by heat, and filter the mixture whilst boiling-hot; the double salt will crystallize as it cools. The mother water that remains contains common salt, and a certain portion of the double phosphate. We cannot, however, obtain the latter by evaporating the mother water, for the common salt would crystallize with it; besides, the double salt becomes acid during the evaporation, and must, therefore, be saturated with ammonia when set to crystallize, if we would obtain a further portion from it. If the salt of phosphorus be not pure, it gives a glass which becomes opaque on cooling. In that case, it must be re-dissolved in a very small portion of boiling water, and crystallized afresh.

"The salt of phosphorus may be kept in large grains, or in powder. The crystals are generally of a convenient size

* Another paragraph on the effects and uses of borax follows here; but, as it has already been given in p. 77, we deem it unnecessary to repeat it.—Editor.

for experiment; heated before the blow-pipe on charcoal, it boils up; intumesces a little, and gives out ammonia; acid phosphate of soda remains, which flows quietly, and forms a transparent colourless glass as it cools: it acts as a reagent principally by means of its free phosphoric acid, and the advantage of employing this salt, rather than the acid itself is, that the latter is very deliquescent; much more costly, and is readily absorbed by the charcoal. The salt of phosphorus therefore, shews the action of acids on the assays; its excess of acid seize on all their bases, and forms with them more or less fusible double salts, whose transparency and colour may then be examined. Consequently, this flux is more particularly applicable to the examination of metallic oxides, whose characteristic colours it developes much better than borax.

"The same flux exerts a repellent action on acids. Those which are volatile sublime, whilst the fixed acids remain in the mass, and divide the base with the phosphoric, or yield it entirely to it: in the latter event, they remain in suspension in the glass, without dissolving in it. In this respect the salt of phosphorus is a good reagent for the silicates; it sets the silica free, which then appears liquefied in the salt as a gelatinous mass."

(*To be continued.*)

XCVI.—*On the Assay of Minerals, by means of the Blow-Pipe. By* M. HAUSSMAN, *Inspector-General of the Mines at Cassel**.

CIRCUMSTANCES NECESSARY TO BE OBSERVED IN THE PREPARATION FOR THE EXPERIMENT-VOLUME OF THE FRAGMENT TO BE ASSAYED.

IT ought to be proportioned to the size of the flame to which it is exposed. If the aperture of the blow-pipe be

* Berzelius in his history of the Blow-pipe says, in a Note—"Professor Haussman is the only person who has given an account, at any length, of the services which Gahn's blow-pipe has rendered to science, in a memoir inserted in the "*Mineral-Taschenbuch de Leonhard*" for

only the diameter of a pin, the volume of the fragment ought not to be larger than a pepper-corn. In order to support the fragment, we may use:—1. Pincers of platina, or with platina points at least. 2. A small glass tube or cylinder, the end of which is to be softened (by heat) in order to fix the fragment to it. 3. A small bit of cyanite, according to Saussure's method. 4. Charcoal, of good quality, particularly poplar and elm, flattened on one side, and with a small hole in it, in which to place the fragment. We may cover this piece of charcoal with another piece, and in this case a passage must be made for the flame, which ought to fall upon the fragment contained in the hole. 5. We may compose a *stud* for support, with charcoal dust pounded in the mucilage of gum tragacanth. We must form of this paste parallelopipedons, and dry them slowly. 6. We may use a small spoon of gold or silver, but above all of platina, the end of which is fixed in a pipe or a wooden handle, to preserve the fingers from being scorched.

As to the method of presenting the fragment to the flame urged by the blow-pipe, we may place it;—1. Half within the flame. 2. In the yellow part of the flame, which produces oxidation. 3. In the blue part, which effects the process of reduction†.

DURATION OF THE EXPERIMENT.

It depends on the different parts of the flame where the body is exposed, and upon the intensity of the heat. This intensity depends on the volume of air which the blow-pipe gives out, *according to the breadth of its aperture, which we may vary occasionally, if the blow-pipe be properly con-*

for the year 1810.—We know not if this be the memoir alluded to by Berzelius; it appeared in the "*Journal des Mines*" Jan. 1811; and our Article is taken from the translation of it in Vol. XXIX. of the Philosophical Magazine. At any rate it contains much valuable information, and some important directions which are not to be found in Berzelius's work.—EDITOR.

† Berzelius finds the contrary effects to take place. See p. 74.—EDITOR.

*structed**; the best is of metal, and in three pieces, a tube, a reservoir, and a point in the form of a cone; the reservoir, placed between the tube and the point, retains the humidity of the breath, and serves at the same time as a moderator (equalizer), by means of the compressed air which it contains. We may adapt to this reservoir; tubes of different diameters, and points with different apertures. We may also produce stronger or weaker currents of air. The abundance of the current of air depends upon the power of the blowing instrument. The air is furnished to the blow-pipe either by means of double bellows, or by the mouth: the air is taken in through the nostrils, and blown out through the mouth; this last is the method most in use, and is most convenient, as it renders the operator more master of the experiment. The stud or support of the fragment to be assayed, is to be held in the left hand, and the blow-pipe in the right, *with the elbows resting upon the table*†. We may also manage the experiment by placing the fragment on a fixed or moveable support; but it is better to hold it in the hand.

The intensity of the flame is different.—1. According to the state of the air which issues from the blow-pipe: it is clear that the stream furnished by the bellows is better than that from the mouth; the difference has but little influence, however, on the result of the experiment.—2. This intensity is different according to the nature of the light employed: a candle, a lamp, or a taper. A candle is better than a lamp, but a wax taper is best of all. The wick, as well as the taper, ought to be flat; and the flame has, of course, a flat appearance‡. The current of

* Here the great utility of Varley's Blow-pipe, with two beaks, must be evident. See p. 245.—EDITOR.

† This most important direction is not to be found in Berzelius's work; and yet we cannot see how it is possible to produce the effects described by him, unless the body and hands are thus rendered stationary. What would Watch-makers or Jewellers be able to perform in their delicate works, unless they operated in this position?—EDITOR.

‡ The wick ought to be divided lengthways in the middle, and the current of air be directed through that channel, in order to produce the best flame.—EDITOR.

air should be so directed as to make the flame act upon the fragment at an angle of 45 degrees. 3. Its intensity is different, according to the different parts of the flame to which the fragment is exposed. The place where this intensity is strongest is the extremity of the blue point of the flame. We get at this point by good management in moving the fragments about to where we find it hottest.

In the course of the experiment we ought to observe the various phenomena presented by the fragments under assay.

In those which exhibit no considerable change in form, we must remark *the various tints* which they assume, on becoming successively heated, from a faint red to a white heat.

Phosphorescence,—When it takes place, presents also various colours, which change sometimes, as we see in the apatite and fluor spar. We may remark also the colour assumed by the flame itself; the sulphate of strontian, for instance, gives the blue part of the flame a reddish tinge. As to changes in the mineral, these may take place without any alteration in its form, such as the change or loss of colour; the surface may become deeper coloured, either in the whole, or in part, as is the case with pyrites.

The yellow oxide of iron becomes totally red; the flowers of cobalt, blue, &c. There is also a change of colour and loss of lustre in white mica, lamellated gypsum, &c. There is a change in the refrangent property when the molecules of a fragment which was diaphanous separate, from the loss of water of crystallization, or the enlargement of their interstices, which frequently gives an opportunity of discovering the texture of various substances, such as ponderous spar, &c. There is also a change of bulk; it diminishes in some, as in potters clay; and increases in others, such as lime, which the action of heat renders porous. Various odours and tastes are also developed by heat, and there may be an alteration of form without change of substance, by the extrication of the water of crystallization, as in alum, borax, &c.

Decrepitation.—When a mineral bursts into fragments,

we must distinguish whether the noise be great, and the pieces large, or the contrary.

Evaporation.—In this case the molecules of a substance are detached in the form of vapour, without any alteration in their substance, as in water, mercury, &c.

Exfoliation.—Separation of the laminæ of a mineral, from which an increase of volume results; as in lamellated gypsum, apophyllite, stilbite, triphane, &c.

Efflorescence,—Is the formation of small mossy excrescences on the edges of the fragment, a phenomenon probably produced by the disengagement of gas.

Formation of Air-bubbles.—Solitary air-bubbles are formed on the surface of the mineral, as on the pyrophysalite, probably by the disengagement of the fluoric acid gas.

General Swelling,—When the mineral increases in volume, by the formation of a multitude of small bubbles which give it the appearance of froth; is this to be ascribed to a disengagement of gas, or to a developement of vapour? It is difficult to say which. This fact is remarkable in the meionite, the lepidolite, &c.

Boiling,—Is when a mineral, entering into fusion, presents the appearance of ebullition, as in borax, mesotype, gadolinite, prehnite, &c.

Rounding of the Edges.—As in talc, &c.

Varnishing.—As in some staurolites, &c.

Frit,—Is when certain molecules are fused, and others are not, as in the rock composed of quartz and felspar; the frit, in this case, affords a method of discovering a mixture, which otherwise would not be apparent.

Scorification,—Is when the whole mass passes into imperfect fusion, so as not to form one, but several globules; as in certain chlorites.

Complete Fusion,—Is when the whole mass becomes completely fluid, and forms globules, or pearls.

Crystallization,—When a fused mineral assumes upon cooling, a regular form, like the phosphate of lead, carbonate of soda, &c.

CHANGES WHICH AFFECT THE FORM AND SUBSTANCE ITSELF.

Combustion or Oxidation.—When all the parts of a mineral, or some of them, are combined with oxygen, the following phenomena result:—

Consumption.—Slow combustion and volatilization of the combustible particles, without flame or smoke; as in the anthracite.

Inflammation.—Rapid combustion with flame; as in pit coal.

Dissipation in Smoke.—Volatilization of the combustible parts, with visible smoke, which is condensed, and adheres to cold bodies; as in coal, native antimony, &c.

Calcination.—Conversion of a mineral into a metallic oxide, of an earthy form: this change may be complete, or only superficial.

Vitrification.—Conversion of a mineral into a vitreous metallic oxide.

Carbonization.—Conversion of a mineral into a charry matter, like coal.

Incineration.—Conversion of a mineral into ashes, by the effect of combustion. It may be manifested at the surface, as in the kohleblende, at the beginning of the experiment; or in the whole mass, as in the braun kohle.

Reduction.—Is effected by abstracting the oxygen from an acid or other mineralizer; as in carbonate of lead, tin ore, cinnabar, &c.

We ought also to observe the circumstances of the other phenomena, which are presented during the course of the experiment: that is to say, whether the minerals are easily and rapidly reduced; or slowly and with difficulty: whether simple or compound—they are simple when one phenomenon only is presented, as in the fusion of compact feldspar; and compound, when several are manifested; and the latter may be simultaneous, as in the smell, flame, smoke, and carbonization of coal; or successive, as in the division, swelling, and fusion of borax.

The change undergone by a mineral may be greater or

lesser, as the greater or lesser part of it is attacked. Universal or partial;—universal when all the particles of a mineral are attacked, as in native antimony, which is totally converted into smoke: and partial, when it affects certain parts only, as in antimonial silver, where the antimony is reduced to smoke, whilst the silver remains fixed.

The ways in which minerals act are various, according to the methods employed.

When the assay is made with additions—We must consider the nature of the substances added, in order to facilitate the fusion of the mineral. Amongst the fluxes, some operate the reduction, and others the oxidation of the metal,—as nitre.

The fluxes employed are either used dry, by mixing them with the mineral, after reducing it to powder; or by melting the mixture, and forming a paste, which is exposed to the action of the flame. Before employing fluxes, it is proper to drive off the water of crystallization from such as contain it.

The fluxes most in use are:—1. *Minium*, for earthy substances. 2. *Fluor Spar*, which is a very good flux for gypsum, with which it forms an enamel. 3. *Gypsum* is reciprocally an excellent flux for fluor spar. 4. *Borax*, which is often employed indiscriminately for earthy and metallic substances; and which frequently also acts as a reductive flux: before employing it, however, we ought to reduce it to glass. 5. *Nitrated borax*, i. e. the superabundant soda of which, is saturated with nitric acid; this is one of the best fluxes, particularly for metalliferous substances. 6. *Carbonate of soda*, which is advantageously employed with siliceous substances. 7. *Carbonate of potash*. 8. *Microcosmic salt*, which is very efficacious. 9. *Glass of phosphorus*, i. e. the phosphoric acid reduced to a vitreous state. 10. *Nitre*, which is an excellent assay for inflammable substances, and a powerful flux for metallic ones.

With the exception of nitre and borax, we may employ the various fluxes on all kinds of supports; but with those

which possess the property of detonating with charcoal, we must use the small platina spoon.

The reductive fluxes are those which either deprive minerals of oxygen, or which prevent it from combining with them.

The charcoal which serves for a support, fulfils this object; but in order to increase the effect, it should be reduced to powder, and be mixed with the mineral before submitting it to the blow-pipe.

Oil is also a very good reductive, when applied to the powdered mineral.

In the assays with additional substances, we observe the way in which the mineral acts with the flux;—if it is fusible, or resists fusion. If fusible, we must notice:—1st, if it be tranquilly. 2d, if it be with the disengagement of gas, as in the fusion of grey manganese with borax. 3d, if it be in the form of froth.

We observe the time necessary for the fusion, as whether it be quickly or slowly performed; as also the colour of the flux, and whether it be permanent or fugacious.

The colour may also change according as we hold the mineral in various parts of the flame: for instance, the glass of borax with a slight addition of manganese, is a violet blue colour, while we hold it in the oxidating part of the flame; and it loses this colour when we pass it into the reducing part.

We observe also, if a mineral has the property of being reduced, whether its reduction be complete or incomplete; as in the red ore of copper when treated with borax.

Detonation—Is another phenomenon in the combustion of inflammable bodies, which must be observed.

THE PRODUCTS OF ASSAYS may be—

1. *A Glass*, i. e. a transparent or translucid body, with a glossy or shelly fracture. We must observe if it be *compact, honeycombed,* or *frothy*, as in obsidian and pechstein; or clear and transparent, coloured or colourless.

2. *An Enamel*, i. e. an opaque body, with a fracture

like wax;—and similar observations as with the above, must be made.

3. *A Scoria*, i. e. a body generally opaque; or at most, translucid, with a surface honeycombed. We must observe if its fracture be dull, vitreous, or metallic; and its colour black, brown, &c. We observe if it possesses any polarity, like that of chlorite, some micas, &c.

4. *A Frit*, i.e. a body, the fracture of which presents vitreous particles, and others not vitreous.

5. *A Regulus*, i.e. a metallic globule.

6. *An Ochre*, or earthy substance, containing a metallic oxide; we observe its colour.

7. *A Coke*, i. e. a charry and cellular residue of coal, having much consistence after the combustion of its bituminous part.

8. *A Charcoal*, a black, light, friable substance, composed of hydrogen and oxydulated carbon.

9. *Ashes*, an earthy, pulverulent, alkaline substance, containing molecules of metallic oxides; that is, the residue of the combustion of various bodies; in colour it is grey or white, yellow or reddish.

10. *Flowers*, a very fine pulverulent deposit, produced by the volatilization of certain substances, and which are attached either to the support, or to some cold body placed above it. This deposited matter is sometimes a soot, as in coal; sometimes sulphur, and sometimes a metallic oxide; this last is of various colours; that of antimony and arsenic is white, and that of lead is yellow. The colour is permanent, as in the flowers of antimony; or changeable according to the temperature of the oxide; as we see in the oxide of bismuth, which is yellow so long as it is exposed to the flame of the blow-pipe, and white as soon as it cools.

Lastly, we ought to observe the changes which the products of the experiments undergo sometime after they are terminated; as in the enamel produced by the fusion of barytes, which divides into small fragments a few hours after fusion.

XCVII.—*Queries—on a Water-proof Cement, Artificial Stone, a Cheap Paint, and on a Family Corn-Mill. By* A Correspondent.—*In a Letter to the* Editor.

Sir, *October* 25, 1822.

Living in the country, and inaccessible, but by long land carriage, I am debarred from availing myself of many inventions, which in the neighbourhood of the metropolis contribute to comfort and to economy in living, without much labour to the individual who adopts them, or much inconvenience in procuring them. I am therefore one of a pretty numerous population in our comparatively uncivilized part of the country, who are obliged to be their own contrivers, and to direct workmen incapable of spontaneously shaking off the habits of their antiquated practice, and still more so, of inventing or even of adopting new ones, unless the most detailed and pointed directions are given them.

As your Publication appears to be directed more than any other to the communication of the most useful practical knowledge, and for facilitating the application of science to the purposes of common life, the benefit of which I have experienced in numerous instances,—I have no hesitation in asking for information through the medium of your Journal. I shall be obliged to you, therefore, for your suggestions on the following heads, viz.

1. *A tenacious water-proof cement*, for fastening slates of large scantling, marble, or stone, edge to edge (either mitred or rebated), so as to resist considerable pressure from liquids: I mean such pressure as is exerted by water three feet in depth.

2. The composition of *an artificial stone* for vessels to contain liquids; the same composition serving for ornamental purposes; for instance, for decorating the *exterior* of those vessels, or for jambs and chimney-pieces.

3. *A cheap paint*, which will render British fir-timber durable. There are few inventions which would be more extensively useful, than such a preparation for coating our cheap but perishable materials.

4. A cheap and *convenient family mill*, which will grind well and easily.

Information on these points will be most thankfully acknowledged by one of your most assiduous readers.

REMARKS BY THE EDITOR.

In respect to the first of these Queries, we know of no better *water-proof cements* than the Roman cement, or Tickell's patent cement, which is of the same nature. We know of no *artificial stone* capable of retaining water, and at the same time resisting the effects of frost or bursting in winter. Wilson's substitute for *stone jambs and chimney-pieces* will be found described in the present Number of our Work. As to a *cheap paint*, we know of none better than Vanherman's; the method of preparing which will also be found in the present Number.

The best *family mill* beyond all doubt, is the steel mill originally invented for the use of Bonaparte's army of Russia, one of which was sent to the Society of Arts, &c. &c. by Sir John Sinclair; and an account of it with descriptive engravings was published in the 35th volume of the Society's Transactions. Many of these have been made by different persons in this country, and they are getting into considerable use amongst us, as indeed they well deserve to do.

We need hardly add, that we shall feel grateful for any farther information on the subject of these Queries, which our Correspondents may be kind enough to furnish us with.

XCVIII.—*On Artificial Stone Chimney-pieces. By Mr.* CHARLES WILSON*.

No. 35, Worcester Street, Borough of Southwark, Jan. 28, 1812.

SIR,

I BEG leave to lay before the Society instituted for the Encouragement of Arts, &c. &c. a substitute for Portland-

*From Vol. XXX. of the Transactions of the Society of Arts, &c. &c. In a Letter to the Secretary. The Society voted the sum of Twenty-five Guineas to Mr. Wilson for this invention.

stone Chimney-pieces, made by me, and no other person, at present, in this kingdom; and with such certificates of their utility, as, I trust, will prove satisfactory.

I am, most respectfully, Sir,

Your very obedient Servant,

To C. Taylor, M.D. &c. CHARLES WILSON.

MR. WILSON'S PROCESS FOR ARTIFICIAL STONE CHIMNEY-PIECES.

Take two bushels of sharp drift-sand, and one bushel of sifted slaked quick-lime; mix them together with as little water as possible, and beat them well up together for half an hour every morning, for three or four successive days; but never wet them again after their first mixture.

To two gallons of water, contained in a proper vessel, add one pint of single size, made warm; a quarter of a pound of alum, in powder, is then to be dissolved in warm water, and mixed with the above liquor.

Take about a shovel-ful of the first composition, make a hole in the middle of it, and put therein three-quarters of a pint of the mixture of alum and size, to which add three or four pounds of coarse plaister of Paris; the whole is then to be well beaten and mixed together rather stiff; put this mixture into the wooden moulds of your intended chimney-pieces, the sides, ends, and tops of which moulds are to be made of moveable pieces; and they must be previously oiled with the following mixture:

Take one pint of the droppings of sweet-oil, which costs about one shilling the pint; and add thereto one pint of clear lime-water, made by pouring boiling water on lumps of chalk-lime in a close vessel, till fully saturated: when the lime-water becomes clear, it is fit to be added to the oil, as above-mentioned; and on their being stirred together they will form a thick oily mixture, or emulsion, proper to apply to the moulds.

In forming the side or jamb of a chimney-piece, the mould is to be first half-filled with the sand, lime, and

have likewise sent a pot of white lead, which has been ground with prepared fish-oil; and which, when thinned with linseed-oil, surpasses any white hitherto made use of for resisting all weathers, and retaining its whiteness. I hope my humble endeavours will merit the approbation of the Society, before whom I will, at any time they shall please to appoint, make the various experiments they may require.

Relying on your encouragement, I am, Gentlemen, with due respect, Your most obedient humble Servant,

THOMAS VANHERMAN.

No. 2, Bedford Place, Rotherhithe,
December 11th, 1804.

To refine one Ton of Cod, Whale, or Seal Oil, for Painting; with the Cost attending it.

	L.	s.	d.
One ton of fish-oil, or 252 gallons	36	0	0
32 gallons of vinegar, at 2*s.* per gallon . . .	3	4	0
12lbs. litharge*, at 5*d.* per lb.	0	5	0
12lbs. white copperas†, at 6*d.* per do.	0	6	0
12 gallons of linseed oil, at 4*s.* 6*d.* per gallon .	2	14	0
2 gallons of spirit of turpentine, at 8*s.* per do.	0	16	0
	L.43	5	0

252 gallons of fish-oil,
12 ditto linseed-oil,
2 ditto spirit of turpentine,
32 ditto vinegar,

298 gallons, worth 4*s.* 6*d.* per gallon,

which produces	L.67	1	0
Deduct the expense . .	43	5	0
	L.23	16	0 Profit.

TO PREPARE THE VINEGAR FOR THE OIL.

Into a cask which will contain about forty gallons, put thirty-two gallons of good common vinegar; add to this twelve pounds of litharge, and twelve pounds of white copperas in powder; bung up the vessel, and shake and roll it well twice a day for a week, when it will be fit to put

* The vitreous oxide of lead.—EDITOR.
† Sulphate of zinc.—EDITOR.

into a ton of whale, cod, or seal oil; (but the Southern whale oil is to be preferred, on account of its good colour, and having little or no smell;) shake and mix all together, when it may settle until the next day; then pour off the clear, which will be about seven-eighths of the whole. To this clear part add twelve gallons of linseed-oil, and two gallons of spirit of turpentine; shake them well together, and after the whole has settled two or three days, it will be fit to grind white-lead and all fine colours in; and when ground, they cannot be distinguished from those ground in linseed-oil, unless by the superiority of their colours.

If the oil is wanted only for coarse purposes, the linseed-oil and spirit of turpentine may be added at the same time that the prepared vinegar is put in; and after being well shaken up, it is fit for immediate use, without being suffered to settle.

The vinegar is used to dissolve the litharge, and the copperas accelerates the solution and increases the drying quality.

The residue, or bottom, when settled, by the addition of half its quantity of fresh lime-water, forms an excellent oil for mixing with all the coarse paints for preserving outside work.

Note.—All colours ground in the above oil, and used for inside work, must be thinned with linseed-oil and spirit of turpentine.

☞ The oil mixed with lime water, I call *incorporated oil.*

The method of preparing, and the expense of the various impenetrable Paints.

FIRST—*Subdued Green.*	L.	s.	d.
Fresh lime-water, 6 gallons,	0	0	3
Road dust, finely sifted, 112lbs.	0	1	0
Whiting, 112lbs.	0	2	4
Blue-black, 30 ditto	0	2	6
Wet blue, 20 ditto	0	10	6
Residue of the oil, 3 gallons,	0	6	0
Yellow-ochre, in powder, 24lbs.	0	2	0
	L1	4	1

This composition will weigh 368 pounds, which is scarcely one penny per pound. To render the above paint fit for use, to every eight pounds add one quart of the incorporated oil, and one quart of linseed-oil; and it will be found to be a paint with every requisite quality of beauty, durability, and cheapness; and in this state of preparation does not exceed two-pence half-penny per pound; whereas the coal-tar paint of the same colour is six-pence per pound.

THE METHOD OF MIXING THE INGREDIENTS FOR THE SUBDUED GREEN.

First, pour six gallons of lime-water into a large tub, then throw in 112 pounds of whiting; stir it round well with a stirrer; let it settle for about an hour, and stir it again. Now you may put in the 112 pounds of road-dust, mix it well; then add the blue-black, after which, the yellow-ochre; and when all is tolerably blended, take it out of the tub, and put it on a large board or platform, and with a labourer's shovel mix and work it about as they do mortar. Now add the wet blue, which must be previously ground in the incorporated oil, (as it will not grind or mix with any other oil). When this is added to the mass, you may begin to thin it with the incorporated oil, in the proportion of one quart to every eight pounds; and then with the linseed-oil in the same proportion; and it is ready to be put into casks for use.

Lead Colour.	*L.*	*s.*	*d.*
Whiting, 112lbs.	0	2	4
Blue-black, 5 ditto	0	1	8
Lead, ground in oil, 28lbs.	0	14	0
Road-dust, 56lbs.	0	0	6
Lime-water, 5 gallons,	0	0	6
Residue of the oil, 2½ ditto	0	3	0
Weighs 256lbs.	*L.*1	4	0

To the above add two gallons of the incorporated oil, and two gallons of linseed-oil to thin it for use, and it will not exceed the price of 1½*d.* per pound.

Note.—The lime-water, whiting, road-dust, and blue-black must be first mixed together; then add the ground lead, first blending it with two gallons and a half of the prepared fish-oil; after which thin the whole, with the two gallons of linseed oil, and two gallons of incorporated oil, and it will be fit for use. For garden-doors, and other work liable to be in constant use, a little spirit of turpentine may be added to the paint, whilst laying on, which will have the desired effect.

Bright Green.	*l.*	*s.*	*d.*
112lbs. of yellow-ochre, in powder, at 2*d.* per lb.	0	18	8
168 ditto road-dust	0	1	8
112 ditto wet blue, at 6*d.* per lb.	2	16	0
16 ditto blue-black, at 3*d.* ditto	0	4	0
6 gallons of lime-water,	0	0	6
4 ditto fish-oil, prepared	0	12	0
7½ ditto incorporated oil,	0	15	0
7½ ditto linseed oil, at 4*s.* 6*d.* per gallon,	2	8	9
592lbs. weight.	*L.*7	15	1

This excellent bright-green paint does not exceed three-pence farthing per pound, ready to lay on; and the inventor challenges any colour-man or painter to produce a green, equal to it, for eighteen-pence per pound.

After painting, the colour left in the pot may be covered with water, to prevent it from skinning; and the brushes, as usual, should be cleaned with a painter's knife, and be kept under water.

A brighter green may be formed by omitting the blue-black; and

A lighter green may be made by the addition of ten pounds of ground white-lead.

A variety of greens may be obtained by varying the proportions of the blue and yellow.

Observe, that the wet blue must be ground with the incorporated oil, preparatory to its being mixed with the mass.

Stone Colour.	*L.*	*s.*	*d.*
Lime-water, 4 gallons,	0	0	4
Whiting, 112lbs.	0	2	4
White-lead, ground, 28lbs. at 6*d.* per lb.	0	14	0
Road-dust, 56lbs.	0	0	6
Prepared fish-oil, 2 gallons	0	6	0
Incorporated oil, three and a half-gallons,	0	7	0
Linseed oil, three and a half ditto.	0	15	9
Weighs 293lbs.	*L.*2	5	11

The above stone colour, fit for use, is not two-pence per pound.

Brown Red.	*L*	*s.*	*d.*
Lime-water, 8 gallons,	0	0	8
Spanish brown, 112lbs.	1	0	0
Road-dust, 224lbs.	0	2	0
Four gallons of fish-oil,	0	12	0
Four ditto incorporated oil,	0	8	0
Four ditto linseed-oil,	0	18	0
Weighs 501lbs.	*L.*3	0	8

This most excellent paint is scarcely three-half pence per pound.

The Spanish brown must be in powder.

A good chocolate colour, is made by the addition of blue-black in powder, or lamp-black, till the colour is to your mind; and

A light brown, may be formed by adding ground white-lead.

Note.—By ground-lead is meant white-lead ground in oil.

Yellow, is prepared with yellow-ochre in powder, in the same proportion as the Spanish brown.

Black, is also prepared in the same proportion, using lamp-black, or blue-black.

TO WHITEN LINSEED-OIL.

Take any quantity of linseed-oil, and to every gallon, add two ounces of litharge; shake it up every day for fourteen days; then let it settle a day or two; pour off the clear

into shallow pans, such as dripping pans, for instance, first putting half a pint of spirit of turpentine to each gallon: place it in the sun, and, in three days, it will be as white as nut-oil.

This oil, before it is bleached, and without the spirit of turpentine, is far superior to the best boiled oil; there is no waste, and it has no offensive smell.

THOMAS VANHERMAN.

Note.—From experiments made, it appears that fine sand will not answer the purposes of road-dust in painting; and that this dry dust, collected in high-ways much travelled by horses and carriages, and afterwards finely sifted, is the article recommended, as possessing the properties required*.

No. 2, Bedford-Place, Rotherhithe,
Feb. 11th, 1805.

SIR,

Enclosed you will find a letter from Mr. Hill, West Lavant, Sussex, builder and surveyor to his Grace the Duke of Richmond, with his opinion respecting the painting of his Grace's house and premises, at Earl's-Court, Little Chelsea, which was finished December, 1803; and which letter I request you will present to the Society's Committee, for their inspection.

I am, Sir, &c.

Your respectful humble Servant,

Charles Taylor, Esq. Sec. THOMAS VANHERMAN.

West Lavant, near Chichester, Sussex,
Feb. 7th, 1805.

SIR,

I have just received your letter, dated the 5th instant, and am happy to find that your oil and colour business so well stands the tests of others, as well as that of myself. *The fish oil composition* you made use of, in all the painting you have done at Earl's-Court, Kensington, for his Grace the Duke of Richmond, under my superintendence, in 1802-3, *was fully equal, if not superior, to any painting done*

* It may deserve mentioning, that this article is used by the iron-founders in London, as a lute for their cupula furnaces, in preference to every other material.—EDITOR.

in the usual way, linseed-oil, white-lead, &c. I have also the highest opinion of your coarse composition and fish-oil which you made use on the out-buildings, fences, &c. on the above premises; the great body and hard surface it holds out, must be the greatest preservative to all timbers and fences exposed to the open air, and all weathers. It must also be of the greatest service on plastered stucco, external walls, &c.

If any farther attestation from me, relative to the business you did at the above premises, can be of any service to you, you will command,

Sir, your obedient servant,

Mr. Thomas Vanherman. W. HILL.

No. 21, Mary-le-bone Street, Golden Square, April 9th, 1805.

SIR,

Your favour, announcing to me the reward voted by the Society of Arts, &c. gave me inexpressible satisfaction; and, I trust, my future efforts to merit their approbation, will be found worthy their notice.

I am, Sir, with the greatest respect,

Your humble Servant,

Charles Taylor, Esq. Soc. THOMAS VANHERMAN.

P.S.—I beg leave here to subjoin a receipt for a constant white, for the inside painting of houses; which paint, though not divested of smell in the operation, will become dry in four hours, and all smell be gone in that time.

A CONSTANT WHITE PAINT.

To one gallon of spirit of turpentine, add two pounds of frankincense; let it simmer over a clear fire until dissolved; strain it, and bottle it for use. To one gallon of my bleached linseed-oil, add one quart of the above, shake them well together, and bottle them also. Let any quantity of white-lead be ground with spirit of turpentine very fine, then add a sufficient portion of the last mixture to it, until you find it fit for laying on. If in working, it grows thick, it must be thinned with spirit of turpentine. It is a flat or dead white.

C.—*On Economising Lamp-light in Copper-plate Engraving. By Mr.* EDMUND TURRELL.—*In a Letter to the* EDITOR.

WITH FIGURES.

DEAR SIR, *No. 46, Clarendon Street, Somers Town.*

ECONOMY in the expense of Argand lamps, which require the best sperm-oil for their consumption, must be allowed to be a desirable object. I have often been pleased to see, that, owing to the form and construction of a double writing-desk, one light would very conveniently serve two persons; and having experienced the great expense of providing a separate light for each person employed by me in engraving,—a thought occurred to me some years since, that a work-board might be so contrived, as to enable two engravers to work with one light. This I effected in the following manner: Fig. 2, Plate XVI, represents a plan of such a work-board, at which, two persons may either engrave or etch by one lamp only. *a, a, a, a,* represents a flat board, with the copper-plate, *b,* laid upon it; a portion of the plate is shewn in dotted lines, lying under the board, *c, c, c, c.* The upper board, *c, c, c, c,* is screwed fast to the under board, *a, a, a, a,* at each end; but is kept about half an inch apart from it, by slips of wood being placed between the two. *d,* represents another copper-plate, a portion of which is shewn by dotted lines, as lying under the lamp-board, *e, e.* The lamp-board may either be fixed or not, as convenience may dictate; but it must have a slip of wood fixed under each end of it, to keep it supported at about half an inch above the board, *c, c, c, c,* by which means the copper-plate, *d,* may pass, or slide under it, as shewn by dotted lines at *f.* *g,* shews the position of the lamp, the light of which falls equally upon both plates: and, consequently, saves the expense of one light, when two persons are at work. Where very small plates are mostly engraved, a single board may answer the purpose; as, in that case, it would only require to be a little broader than com-

mon. But when large plates are to be engraved, a provision must be made to enable one of the plates to pass, and lie over or under the other. Fig. 3, shews an end view of the same work-board, or combination of boards; the same letters of reference being applied to the similar parts. In this figure the legs of the board are shewn as broken off; but where there is a work-board already fixed against the window of the room, this kind of board may be made without legs; for in that case, one end of it may be fastened to the board used in the day-time, by thumb-screws, or any other convenient method; and two moveable legs may be placed under the other end, which will hold and support it firmly; and when done with, it may be unscrewed, and set up against a wall, as it will then occupy very little room. When the work-board used in the day-time is not affixed to a window, it may be lifted away from its former position, and have the upper board, *c*, *c*, *c*, *c*, fixed upon it, by thumb-screws, which should pass through the slips at each end; and, in this way, there would be nothing to remove, but the upper board.

Although there may be no great deal of contrivance displayed in the construction of this work-board; yet a great deal of comfort and convenience is experienced in the use of it; for in winter evenings, it enables two persons to work much nearer to the fire, than when separate work-boards and lamps are used.

I am, Sir,

Your obedient Servant,

T. GILL, *Esq.* EDMUND TURRELL.

CI.—*On Instruments for Drilling and Boring.*

[Continued from p. 337.]

WITH FIGURES.

MR. JACOB PERKINS'S IMPROVED AUGER.

IN our description of the American Twisted Centre-bit*, we have shewn the stem of it as being formed of a flat

* See p. 335.

twisted iron bar, and the stems of the improved drills and gimlets, also described by us*, are formed of solid iron cylinders, which have afterwards helical grooves made around them. In this improved auger, however, (see Plate XVI, fig. 4,) the stem is made of a bar of iron, previously formed in a proper tool to the semi-cylindrical shape, shewn in section at fig. 5; and afterwards coiled into the screw-like form shewn in fig. 4.

In this excellent construction, great strength is afforded to the stem of the auger; whilst, at the same time, every facility is afforded for the free escape of the borings as fast as they are made.

The nose, or cutting part of this auger, does not differ much in shape from those in common use;—its shape will be readily understood, from figs. 4 & 6: the side towards the right hand, where the steel is joined to the iron stem, is made solid, for the sake of strength; but the left side is hollowed, and formed into two sharp edges, at right angles to each other: the outer edge projects a little beyond the circular end of the auger, as shewn in fig. 6, in order to afford free space for the stem to turn in the hole bored by it.

It hardly need be added, that the workman, in using this excellent auger, has no occasion to draw it out of the hole continually, to free it from the borings, as in using the common augers—the borings escaping as fast as they are produced.

The stem of this auger may be made from 12 to 14 inches long, and have at the opposite end to its nose, either a taper shank, to be fitted into a hole, made in the middle of the wooden handle, as usual; or, which is better, have an eye or socket, through which the handle may be put, and secured for use.

* See p. 336.

CII.—*On the Preparation of the Acetate of Lead, in France**.

Acetate of Lead, *Salt of Lead, Sugar of Lead.*—This salt is become a subject of important manufacture in France, since linen and cotton prints have got so much into vogue. It forms one of the bases of the mordant employed in those works. It is probable, however, that in time a much smaller quantity of it will be used, as the *acetate of lime* may be employed in its stead; this latter article, being produced at a much smaller expense, and possessing the same property of decomposing alum, and transforming its base into an acetate.

It is doubtless fortunate on some accounts, that the use of this product has changed hands; for it was used in several parts of France for the sweetening and fining of wines of inferior quality, and which are naturally acid: but as it is become necessary to supply enough for the increased demands of the manufacturers, and as the pyroligneous acid offers greater advantages, both these articles have become of increased importance.

Formerly the acetate of lead was prepared with distilled vinegar and metallic lead. This process is described in the 37th Vol. of the *Annales de Chimie*, by M. Pontier, and communicated by M. Vauquelin. At this period some of the manufacturers used white-lead for this purpose; but besides the difference which its use made in the expense, there was also the disadvantage of employing a portion of the acid at a dead loss, by the saturation of the chalk contained in the ceruse. The acetate of lime which was produced, increased the bulk of the mother-waters, and prevented crystallization. We shall here give, in a brief manner, an idea of this process, as described by M. Pontier.

As the metallic lead is not directly acted upon by the acetic acid, it was necessary to oxide it in part, by calling in the aid of the air. The following was the process:—

* From the *Dictionnaire Technologique.*

Instead of *laminated* or *rolled* lead, they employed *cast* lead, the former not being sufficiently porous; this was divided into slips, by means of shears, and distributed in earthen pots, into which was poured distilled vinegar, but in too small a quantity for the lead to be entirely covered therewith. That portion which was not covered, was however slightly moistened, and being exposed to the joint action of the air and acid, in a little time became oxidized; and as soon as the white efflorescence thus produced was apparent, the pieces were reversed, in order to present fresh surfaces. This operation was repeated many times during the day, until the acid at length assumed a greyish tint, or milky appearance, because, in dissolving the oxide of lead, it also received some metallic particles carried off with it by friction. It may easily be conceived that the greater or lesser progress of the operation depended upon the strength of the acid—the dryness of the atmosphere—its temperature, and upon various other causes, which the manufacturer was fully aware of, but which he could not always regulate. When the acid no longer acted upon the metal, all the solutions were put into a tinned copper-boiler, and subjected to a boiling heat. The saturation is effected, because the acid, by the advantage of concentration, dissolves those portions of metal which remained in suspension. After being reduced to one-third, the liquor was filtered, and then the concentration finished, that process being continued until a little of the solution taken out for trial, became susceptible of crystallization instantly on cooling. It was then suffered to remain at rest for a few minutes, before decanting and setting it to crystallize. They obtained from this first evaporation, masses of needle-shaped crystals, of a tolerably white colour; but those furnished by the mother-waters, on evaporation, were more and more discoloured.

It would be easy to prove that this process is subject to numerous inconveniences. As M. Pontier, however, has pointed out the chief of them, it will be useless to dwell

onger on this subject; it will be better to proceed immediately to describe the means actually used, and which are far preferable to those above mentioned, as they are founded on an exact knowledge of the nature and proportions of the salt.

It is well known, from the best analyses, that the acetate of lead is composed, in round numbers, of 58 oxide, 26 acid, and 16 water. We must begin then, by determining the saturating power of our acid, in order to find the quantity of real acid which it contains. This being ascertained, we endeavour to find what quantity of the given acid will correspond with 26 parts of dry acid, or 2600 of real acid. Now, supposing that the given acid be at 40° of the acid-metre, which nearly corresponds with 8° of the areometer, it is certain that it will be necessary to take 65 kilogrammes, because $65 \times 40 = 2600$. In effect, if we pour 65 kilogrammes of the acid at 40°, on 58 kilogrammes of litharge, the solution is immediately effected; and so suddenly and completely, as to produce sufficient heat to hold in solution all the salt formed, in spite of the concentration of the acid. Notwithstanding, it is better to apply a little heat under the boiler to effect the solution, and then to suffer it to remain a little time at rest, before distributing it into the crystallizing vessels. The proportions which we have indicated, are exact, for the reciprocal saturation; but the liquid would be too much concentrated, and would afford a confused crystallization: we are then obliged to dilute it with the water which has served to wash the vessels in which the solutions, &c. were made; of this it is necessary to add as much as will bring the boiling liquor to mark 50 or 55°, and then suffer it to repose for some time. When the liquor appears clear, it is poured into the earthen vessels, and left to crystallize. After thirty-six hours, the crystallization is generally finished; the pots are then placed on their sides in a row, on a long bench, the surface of which is slightly inclined, and conducts the liquor which drains from the crystals into a small reservoir. The salt

is then dried in a stove moderately heated, on account of its tendency to effloresce. Finally, To prepare the salt for market, it is put into barrels, well dried, and which are generally lined with blue paper, in order to give the salt a more agreeable appearance. They obtain from the first operation 75 kilogrammes of acetate of lead in fine crystals, and very white; 25 kilogrammes consequently remaining in the mother waters. What is produced by evaporating the mother waters is never so fine as the first; and it is therefore usually retained, to be employed in the successive operations. When the mother waters refuse any longer to crystallize, they employ them, by decomposing them with carbonate of soda, to obtain acetate of soda and carbonate of lead, from the former of which they can easily produce, by means of sulphuric acid, the acetic acid by distillation. The first method is most advantageous, as we can equally extract the acid from the acetate of soda, and also much of the carbonate of lead, which, after being well washed, affords, with the acetic acid, a beautiful acetate, whilst no use is in general made of the sulphate of lead*. It is, however, better to withdraw the mother waters; and instead of concentrating them by heat, which always discolours them, to let them again enter into the new solutions; and we shall then finally obtain, in the first crystallizations, according to the proportions above indicated, 100 kilogrammes of acetate of lead, instead of 75 kilogrammes only. The mother waters, in spite of this addition, will retain only the same quantity of salt. Thus this method is truly preferable. Unfortunately, however, it cannot be practised indefinitely; a certain time arrives when the mother waters become viscid, which retards the crystallization, and prevents the salt from forming; and thus we are forced at length to resort to concentration, &c.

To these general observations I shall add some details, which may be useful for the success of the process.

* See however the Article by Berthier, "On the use of Sulphate of Lead in the Arts," p. 311.—Editor.

And first it may be observed, that we may vary the degree of concentration of the solution a little, according as we would produce a salt of greater or lesser density:—thus, we can vary it from 55 to 48 degrees, agreeably to circumstances. It is certain, that the more the solutions are concentrated, the denser are the crystals. We can thus easily suit the different wishes of the consumers.

I have already observed, in respect to the acid, that it ought to be taken at eight degrees of the areometer, in order that the solution may be quickly effected. I have also to observe, that the acid must be pure and well freed from the empyreumatic oil and sulphuric acid. The latter would form an insoluble sulphate of lead entirely useless, and the oil would discolour the solution, &c.

Formerly it was particularly recommended to employ English lead for this manufacture. At a later period it was found, however, that the lead of France would serve equally well, only taking care to free it from the copper it contained;—this is easily effected by putting into the boiler a few pieces of rolled lead. It is the same with regard to litharge. It must be observed, however, that many manufacturers are careless about separating the copper: they are, however, compelled to do it in some degree by the consumers, as they do not willingly give a preference to that salt of saturn which has a slight azure tint.

When we treat litharge by the acetic acid, there always remains a very small quantity which will not dissolve. This residue, however small, is not to be despised, as it contains a notable quantity of silver, a little oxide of lead, probably at the maximum, some oxide of copper, and some earthy substances. When a sufficient quantity is collected, it must be treated in the same manner as silver ores.

It will no doubt be remarked, that in the process we have just described, there is no necessity for concentrating the solutions to cause them to crystallize. This is an advantage which cannot be too highly appreciated in this manufacture; for, the solution of acetate of lead is decomposed

merely by the heat of ebullition, and forms a carbonate of lead, which must at last be taken up, by the addition of more acid. We see then, how desirable it is, to be able to operate immediately with a concentrated acid. If we consider, that according to the old process, we were exposed, by reason of the great variations in the qualities of the vinegars employed, to obtain very defective results, however expert the manufacturer might be; whilst in the new process there is not the least uncertainty, even when a workman, the least intelligent, directs the operation;—we shall acquire a just idea of the important services which chemical knowledge has rendered to this branch of our industry.

The acetate of lead, in respect to its chemical character, possesses some properties which it will here be useful to mention. This salt, in solution, does not appear to have any affinity for water, as it does not sensibly retard its point of ebullition: nevertheless, in its crystallized state it still retains 15 or 16 per cent. It is true, that it effloresces on its surface when it comes into contact with warm air; but this efflorescence is very limited; and we never see that the salt loses its crystallized form, and falls into powder, as the sulphate of soda does. If in its crystallized state it be exposed to a heat approaching to ebullition, it is instantly liquefied, and becomes exceedingly difficult to dry again; for which reason it ought never to be suffered to approach to the melted state. In any case, however, when we have succeeded in freeing it from its water of crystallization, it becomes susceptible of experiencing a new fusion, and at a lesser degree of heat than that of boiling oil; it then becomes perfectly limpid; its decomposition presents phenomena which, however, it is not our intention to describe here. I wish only to make known its principal properties, in order that manufacturers may not attempt to purify this salt by simple torrefaction, as many have endeavoured to do. They pretended to make the acetate of lead with the crude acid, and by a slight calcination to free it from its empyreumatic oil; but they only decomposed the acetate.

There is also another property of this salt, which I should not neglect to make known to those manufacturers who are but little versed in the study of chemistry, especially as it often becomes a source of great embarrassment, and frequently occasions considerable losses:—and this is, the property which this salt possesses of charging itself with a new dose of its own oxide, and thus forming a sub-salt, much more soluble, and which, on mixing with the common acetate of lead, renders its solution viscid, changes the form of the crystals, makes them pasty, gives them a greasy appearance, and hinders their drying. This inconvenience frequently presented itself in the old process. The heat necessary to concentrate the solutions, was sufficient to volatilize a portion, more or less considerable, of the acid, and to decompose another portion of it. The superabundant oxide was retained in solution by the acetate, and formed a sub-salt. This combination however, so disadvantageous in this particular circumstance, and which Scheele first pointed out, becomes to us, in another respect, a source of advantage; as it furnishes the means of making in our own country an article of great consumption, and which we were formerly obliged to obtain from other countries: it is important therefore to describe the process at length.

The sub-acetate of lead contains three proportions of oxide; that is to say, the neutral acetate requires, in order to pass to the state of a sub-acetate, twice as much oxide as it contained at first. This combination is generally directed to be made by the aid of heat; but it may be perfectly well effected, and more conveniently, in the cold: in truth, it requires a little more time; but then it occasions less loss. When we produce this re-action of the acetate of lead upon its protoxide, whether in the cold or at an elevated temperature, it always deposits a white magma, but little soluble; and which has always been considered until now, as a carbonate of lead; but which may well be considered as of quite another nature. It is even

probable that it may, in a great part, be formed of that second sub-acetate of which M. Berzelius has made mention. However it be, very little of it is formed at the ordinary temperature, particularly if it be not mixed with an excess of oxide. This is precisely the motive why we give the preference to the following process:

We take two kilogrammes of salt of saturn, and dissolve it in five kilogrammes of water: we then add one and a half kilogrammes of pulverized litharge; we beat it well up many times during the day, and from time to time, add a little water. At the end of two or three days, the combination is generally effected: we then decant and filter. There remains about 400 grammes of litharge undissolved. It is from this sub-acetate that we obtain *the Ceruse of France.*

CIII.—*On the Preparation of Artificial Slates**.

THERE have been for some years imported into Russia a species of Artificial Slates, manufactured by a person named *Alfuid Faxe*, of Carlscroon. These substances attracted the notice of several scientific men. M. Géorgi was instructed by the Academy of St. Petersburg to make an analysis of them, by which means he discovered their composition. They are a most invaluable substitute for slates; as they are much lighter, impenetrable by water, and incombustible. The following processes for manufacturing them, afforded the best results to M. Géorgi.

The substances employed, were 1st, A bolar earth, white, red, or ferruginous, according to circumstances. 2d. Chalk or Carbonate of Lime. 3d. Strong or English Glue. 4th. The Pulp of Paper. 5th. Linseed Oil.

The bolar earth and the carbonate of lime are reduced to powder separately, in a mortar, and passed through a silken sieve.

The glue is dissolved in water, in the usual manner.

The paper pulp employed is such as is known by the

* From the *Dictionnaire Technologique.*

paper-makers, under the name of common paper pulp, (*papier bulle*). This is steeped in water, and the water afterwards extracted from it by means of a press. Instead of this pulp, we may employ with advantage the waste of white paper, or book-binders' cuttings; these must be boiled for twenty-four hours, and the water squeezed out by means of a press.

The linseed-oil employed must be raw.

The mass of paper being mixed in a mortar, with the dissolved glue, is made into a paste, by adding the bolar earth and carbonate of lime. The whole being well beaten together in the mortar, the linseed-oil is poured in from time to time, as fast as it can imbibe it. They then take a quantity of this mixture, and spread it with a spatula on a plank or board furnished with a ledge or border, to determine the thickness of the layer;—before this is laid on, however, the plank is covered with a leaf of common paper. They then place upon this mixture another leaf of paper, on which they lay another plank, and reverse the whole: they then lift off the bordered plank, together with the first sheet of paper. After this operation, they again reverse the *stone paper*, and lay it upon a plank strewed over with very fine sand by means of a sieve: they then remove the second plank, and the second sheet of paper; leaving the sheet of composition to dry.

These sheets neither crack nor break in drying; but they are liable to become twisted out of shape, and they are seldom smooth, or without lumps on their surface. To remedy these inconveniences, they are passed between the two cylinders of a flatting-mill, which perfectly unites and gives them firmness: they are then submitted for some time to the action of a press, which makes them perfectly straight and even. And, lastly, the two surfaces of each sheet are coated, either with boiled linseed-oil, or linseed-oil rendered drying by a little oxide of lead.

The following are those compositions which have afforded the best results:—

1st. One part of pulp (made from old paper and book-binders' cuttings), half a part of glue, one part of chalk, two of bolar earth, and one part of linseed-oil—form a thin, hard, and very smooth sheet.

2d. One part and a half of paper pulp, one of glue, and one of white bolar earth—produce a sheet very beautiful, hard, and uniform.

3d. One part and a half of paper pulp, two of glue, two of white bolar earth, and two of chalk—produce an uniform sheet, as hard as ivory.

4th. With one part of paper pulp, one of glue, three of white bolar earth, and one of linseed-oil, we obtain a beautiful sheet, which has the property of being elastic.

5th. One part of paper pulp, half a part of glue, three parts of white bolar earth, one of chalk, and one and a half of linseed-oil—form a sheet infinitely superior to that obtained by the process No. 4. This substance has also the property of retaining whatever other shape may be given to it. A few grammes of Prussian blue give it a bluish-green tint.

We may substitute with advantage, in place of the carbonate of lime and the bolar earth (of which we have above spoken,) the *carbonated pulverulent lime*, which Fabbreni discovered in Tuscany; of which he manufactured his floating bricks, and to which he gave the name of *fossil farina*. In the year 1800, Faujas discovered in the department of Ardèche, four leagues distant from the banks of the Rhone, a considerable bed of this earth, in a place readily accessible. This substance is not rare. Brongniart assures us that it is found, in a layer of a centimetre in thickness, on the lower or lateral surfaces of beds of coarse carbonate of lime. It is frequently found in the environs of Paris, but more particularly in the quarries of Nantz. This earth is white, as light as cotton, and is reduced to powder by the least pressure.

The various experiments made on these sheets of stone-paper, or artificial slates, have proved:—1st. That by a

continued steeping in cold water for four months successively, they did not in the least change, nor increase in weight. 2dly, That on being exposed to a violent heat for five minutes, they were scarcely altered in form; but were converted into black and very hard plates: they merely appeared blackened, and somewhat scorched. They constructed a house of wood at Carlscroon, which was entirely covered and lined with these articles; they then filled it with combustibles, and set fire to it: the house resisted the action of the flames.—The experiment was repeated at Berlin, and with the same success.

The materials fit for making this stone-paper are to be found in all parts of the globe. The process is simple, and it requires only very facile manipulations: it may be used, with economy, for covering houses, instead of slates; and for which purpose its lightness renders it far preferable. In this case, it is secured, in large leaves, by copper nails, and the joints filled with cement. The whole being coated with an oil-colour, forms the lightest covering, and one the least penetrable by water.

The cement which we recommend for filling the joints between these sheets after being nailed on, is composed of linseed-oil rendered drying, white-lead and chalk, intimately mixed, and used in a nearly fluid state, in order that the composition may the better insinuate itself amongst the joints and interstices, and cover the heads of the nails.

We have seen, in the Exhibition at the Louvre, in the year 1819, the *stone-paper* invented by *M. Hirsch*, which is white, and possessed of all the properties of the composition described in No. 4. This artist kept his process secret; but we believe it to be the same as is employed in Sweden—as that discovered by M. Géorgi, and which we have here described. L.

CIV.—*On the Preparation of the Acetate of Potash, in France**.

Acetete of Potash: *Terra foliata tartari, sal diureticus.*—This salt is much used in medicine, and is considered as a powerful diuretic, and an excellent solvent. It was formerly prepared by saturating distilled vinegar with salt of tartar, or purified sub-carbonate of potash; but almost all the makers of it now employ the pyroligneous acid. Some, however, pretend that these two modes of preparation do not furnish the identical medicament. It does not appear that their objection is well-founded; for we cannot admit that the small portion of vegeto-animal matter taken up by the vinegar, during its distillation, is sufficient to have a decided influence on the medicinal properties of the acetate of potash. If this opinion is not quite erroneous, it is at least unsupported by proof. However it be, it has been usual to endeavour to obtain the article as white as possible; and this effect was formerly obtained by some particular manipulation, which was made a secret of. M. Fremy, of Versailles, thought he perceived that the discolouring of the acetate of potash was owing to the reaction of the alkali on the vegeto-animal matter; and he therefore advised to take the precaution of pouring the solution of potash into the vinegar, so that it might be saturated at once, and thus rendered incapable of receiving any influence from the substance before mentioned. If we follow the contrary method, and add the vinegar, by degrees, to the alkaline solution, then each portion of the acid is found, according to the same author, enveloped in a great mass of potash, which attacks and decomposes in part the quality contained in the vinegar; and hence it arises that the acetate thus obtained, is less white than the other. In any case, it is always possible to obtain it perfectly white, by adding to the hot concentrated solution a

* From the *Dictionnaire Technologique*.

small quantity of animal charcoal, and putting the whole into a state of ebullition for a few minutes. This mixture, diluted with water, filtered and evaporated afresh, produces the acetate as white as possible. In order to procure this preparation of a suitable quality, we must use the carbonate of potash, obtained from the combustion of tartar, or at least from pearl ash, which has been submitted to a fresh purification. A simple solution in water suffices for this purpose; but we must be careful to do it in the cold, and in the smallest possible quantity of fluid. By this method the greater part of the foreign salts are separated; such as the muriate and sulphate of potash, which are readily disengaged from the sub-carbonate, on account of their being less soluble; but, in spite of this precaution, it is impossible to prevent the potash from carrying with it a certain quantity of silex in solution. This earth is only removed by the complete saturation of the alkali with vinegar; and often it is not till after a certain degree of concentration of the acetate that it is perceived to be precipitated, and that we are obliged to filter the liquid to get rid of it. There is another period at which the evaporation ought to be suspended; that is, when the liquid has almost attained a sirupy consistence: it does not ordinarily crystallize on cooling or by being suffered to remain at rest.

The solution of the acetate of potash, thus purified, is at length submitted to a final evaporation, to obtain the salt in a dry state. But there is one circumstance that must not be forgotten, and that is, to keep it well up to the point of saturation; for it generally happens that a part of the acid is volatilized by the action of heat, and that the acetate becomes alkaline. We must therefore add, from time to time, according to circumstances, a sufficient quantity of distilled vinegar.

Provided attention be paid to all the preceding remarks, no other care is requisite to accomplish the operation, than to separate the concentrated solution, and carefully ma-

nage its evaporation. If we were to operate on considerable quantities, the prolonged action of the heat would decompose a fresh portion of acetate; and we should be obliged to repeat, incessantly, the saturation. We must therefore evaporate only small quantities at a time, but in a large vessel; because, in proportion as the pellicle is formed, and the acetate exfoliated, it must be taken off with a large spatula, and laid on the side of the boiler to terminate its desiccation. When it is deemed to be sufficiently dry, we hasten to enclose it, still hot, in a very clean earthen pot, well closed; and when it is perfectly cold, it is distributed into glass jars and well corked, with pitch over the corks: for so powerfully does this salt attract humidity, that too much pains cannot be taken to keep it from the air.

When we make use of the purified pyroligneous acid, for this preparation, the operation goes on as we have described; and our observations will suffice: but if it is intended to make use of the crude acid, or even that which has been but half purified, we are then obliged to destroy the tar contained in the acid, by exposing the acetate to complete igneous fusion, and also to add a little animal charcoal, in order to render it white; but even then there is a considerable quantity of alkali remaining, which must be saturated afresh, with pure acid.

The neutral acetate of potash is not susceptible of crystallization; the needle-shaped crystals which are formed in these very concentrated solutions, are acids.

CV.—MISCELLANEOUS.

On the Manufacture of Oil-Gas from Seeds, in France.

The Company formed for Lighting Paris with Gas from oleaginous seeds, particularly those of hemp and rape, have commenced their illumination, and with complete success. They have proved, that instead of retrograding in science, as some of our cotemporaries asserted, their system is superior to any other.

The gas is produced, as we have before mentioned, from the seeds, and passes at once into the gasometer; no purification whatever being necessary.

The gas has no smell, and its illuminating power is estimated (as we should suspect, rather too highly) at double that of coal-gas; and it is also much superior to the oil-gas obtained by the usual process.

Query, on consuming the Smoke of Iron-Foundries. In a Letter to the EDITOR.

Cardiff Iron-Foundry, Glamorganshire, Nov. 18, 1822.

SIR,

IN your Technical Repository for January and February, you have noticed "Sheffield's Air-Conductor for Furnaces," and "Johnson's Smoke Burner for Steam-Engine Boilers, &c."; but it does not appear that the introduction has been generally adopted for the furnaces of iron-foundries, &c. We therefore should feel much obliged by your informing us, through the medium of your interesting and useful work, if it has been successfully introduced into establishments of that kind. If the inconvenience arising from the smoke of iron-foundries, can be obviated without deteriorating the quality of the iron, your giving publicity to that fact, will be a stimulus for its prompt adoption, and will also be conferring an obligation upon the inhabitants generally of this manufacturing country, but more particularly those in the immediate vicinity of such works.

We are, Sir,

Your most obedient Servants,

T. GILL, *Esq.* EDWARD BIRD, JUN. & Co.

We shall feel particularly obliged by any of our readers favouring us with accurate information on this truly interesting subject, and which we shall not fail in communicating, for the benefit of the public. EDITOR.

On French Cutlery of Damascus Steel.

WE gave an extract, p. 286, from the *Rev. Ency.* on the very extraordinary properties of Cutlery made of the *French*

Damascus-Steel; and in particular, *that Lancets made hereof by a certain cutler in Paris, would pass with the greatest facility through pieces of parchment and thin plates of lead, without any injury to the edge.*

We requested our Correspondent at Paris to make particular inquiry into the truth of this assertion; and, accordingly, he called upon the cutler, and informed him of the above statement; to which he very modestly replied, that the Article was inserted in the Review entirely without his knowledge, and that *the properties of his cutlery were very grossly exaggerated*, for which he was exceedingly sorry; that, it was true, he could make lancets, &c. capable of doing all that was mentioned; but then, their edges would be too thick and clumsy to perform their proper offices.—So much then for the boasted superiority of the French cutlery.

Fatal Accident from Fulminating Powder.

On Tuesday afternoon, the 12th instant, the neighbourhood of Mary-le-bone was thrown into the greatest state of alarm, in consequence of an explosion taking place at the house of Mr. Hall, a gun-smith, of Upper Mary-le-bone Street. It appeared that Mr. Hall is a maker of the primings for percussion guns, and carried on that business in the upper part of his house; and two youths named Alexander and John Bettie, of the ages of ten and twelve years, were engaged in preparing the primings. Mr. Hall being from home, had left the two youths and his son at work. The primings are composed of (oxymuriate or chlorate of) potash, charcoal, and sulphur. Mr. Hall, jun. had gone down stairs from the work-shop, and was in the act of returning when the explosion took place. On his entrance into the room he found the before-mentioned boys lying on the floor, bleeding and covered with wounds; every pane of glass and part of the sashes had been blown out; the force of the explosion had torn down the stone fire-place, and taken the doors off their hinges; the whole of the

ceiling of the room underneath fell, and the windows in the stair-case were blown out. On examining the boys, one was found to be dead, and the other injured in so dreadful a manner that he died the same night. About five ounces of the primings had exploded; and it is supposed that a spark from a candle, accidentally falling on it, had caused it to explode; there being at the time two ounces more in another part of the room.

On Wednesday evening, at seven o'clock, an inquest was taken before T. Stirling, Esq. coroner, in the surgery-room at the Middlesex Hospital, on the above bodies, when the jury returned a verdict of—"Accidental death, by the explosion of fulminating powder, *for want of attention of the employers.*"

Caution to Millwrights; and a Providential Escape.

A FEW days ago, four men, in the employ of Messrs. Humber and English, were putting up a large iron spur-wheel at the Wortham Brewery, on the upright shaft that turns the stones for grinding malt above. The wheel was fixed horizontally, but not sufficiently true; when one of the men seated himself upon a cross-plank underneath it. He touched one of the wedges, and the whole came down upon the poor fellow, with a tremendous crash, and who was supposed to be crushed to atoms; but it was soon discovered that the plank had broken, and allowed his body to drop. His head had passed through a space of ten inches wide only, between two of the iron arms of the wheel, whereby he escaped instantaneous death. He is in a fair way of recovery, suffering only from the severe bruises on his shoulders.

The Surrey Institution.

THIS Establishment, having nearly exhausted its funds, is, it seems, to terminate early in the ensuing year. We, however, can see no reason why it might not continue to exist, by an appeal to its members and the public to come

forward with renewed subscriptions; and we would recommend the adoption of the system pursued in the Society for the Encouragement of Arts, &c. &c. and under which it has continued to flourish for upwards of half a century, which is, to have annual subscribers of two guineas and upwards, paid in advance; or members for life, upon the payment of twenty guineas.

Instead of which, *A Prospectus of a New Surrey Institution* has been sent to us, in which it is proposed to raise the sum of *Fourteen Thousand Pounds, by seven hundred shares of* TWENTY-FIVE GUINEAS *each.* Nor is this all; for it is also proposed, that each share-holder shall besides *be made responsible for the payment of* TWO GUINEAS PER ANNUM.

We must needs own, that in the present times we think it hardly probable that such a project can be realized.

LIST OF PATENTS FOR NEW INVENTIONS,

which have passed the Great Seal, since Oct. 25, 1822.

To Thomas Leach, of Blue-Boar Court, Friday-Street, Cheapside, in the City of London, Merchant; in consequence of communications made to him by a certain Foreigner residing abroad, for an improvement in Steam Engines, by the application of Steam immediately to a wheel, instead of the usual process. Dated Oct. 25, 1822.—To be specified in four months.

To William Piper, of Cookley Iron-works, in the parish of Wolverley, in the county of Worcester, Civil Engineer; for his invention of several new Anchors, for the use of Shipping and other Vessels. Dated Nov. 1, 1822.—In two months.

To Alfred Flint, of Uley, in the county of Gloucester, Engineer; for a Machine for Scouring, Prising, and Washing of Woollen Cloths. Dated Nov. 1, 1822.—In two months.

To John Oxford, of Little Britain, in the City of London, Gentleman; for his improved method of preventing premature decay in Timber, Metallic Substances, and

Canvas, by the application whereof, to such several bodies respectively, the same are respectively rendered impervious to the dry-rot, damp-rot, worms, insects or rust, to which the same are respectively liable; and the same are thereby rendered more durable and less liable to decay. Dated Nov. 1, 1822.—In two months.

To John Dowell Moxon, of Liverpool, in the County-Palatine of Lancaster, Ship-Owner and Merchant; for his Improvements in the Construction of Bridges, and works of a similar nature. Dated Nov. 9, 1822.—In six months.

To Francis Deakin, of Birmingham, in the County of Warwick, Sword-Manufacturer and Wire-Drawer; for an improvement in the Manufacture of Holster Cases, Cartouch Boxes, and certain other descriptions of Cases. Dated Nov. 9, 1822.—In two months.

To John Jekyll, of Roundhill House, in the parish of Wincanton, in the county of Somerset, Captain in his Majesty's Navy; for certain Improvements in Steam or Vapour Baths, to render the same more portable and convenient than those in present use. Dated Nov. 9, 1822.—In two months.

To Richard Roberts, of Manchester, in the County of Lancaster, Civil Engineer; for certain Machinery or Implements, applicable to the process of weaving plain or figured Cloths or Fabrics, which may be used on and in conjunction with Looms now in common use; and also certain improvements in the construction of Looms for weaving plain and figured Cloths or Fabrics, and in the method of working Looms either by hand, by steam, or other power. Dated Nov. 14, 1822.—In two months.

END OF VOL. II.

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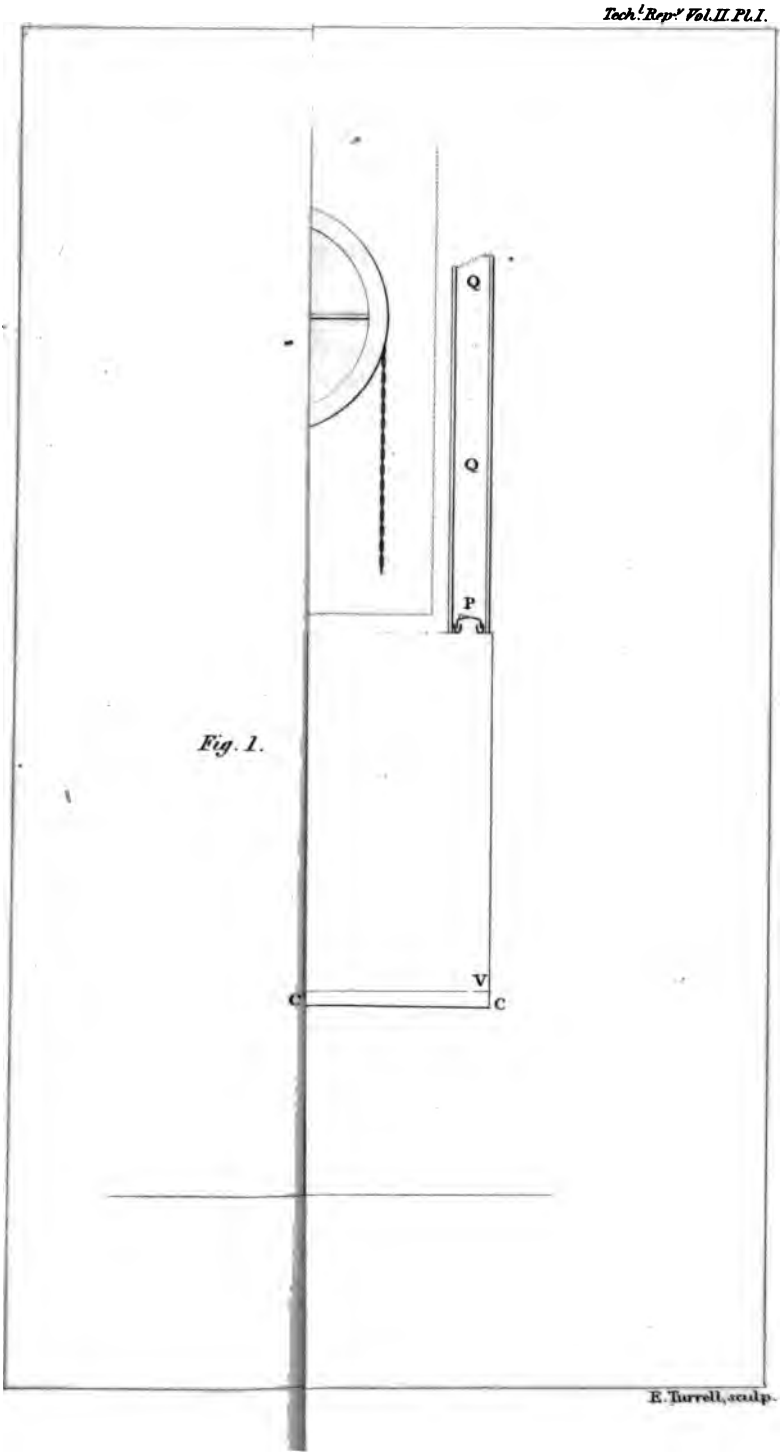

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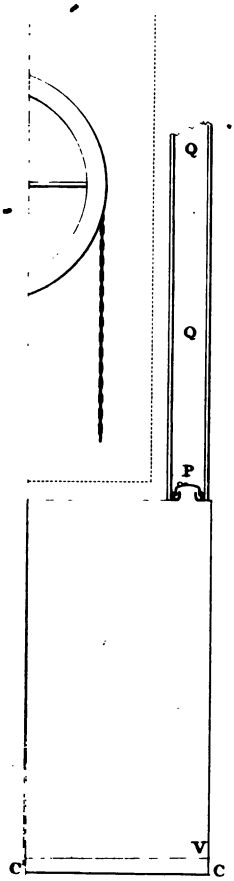

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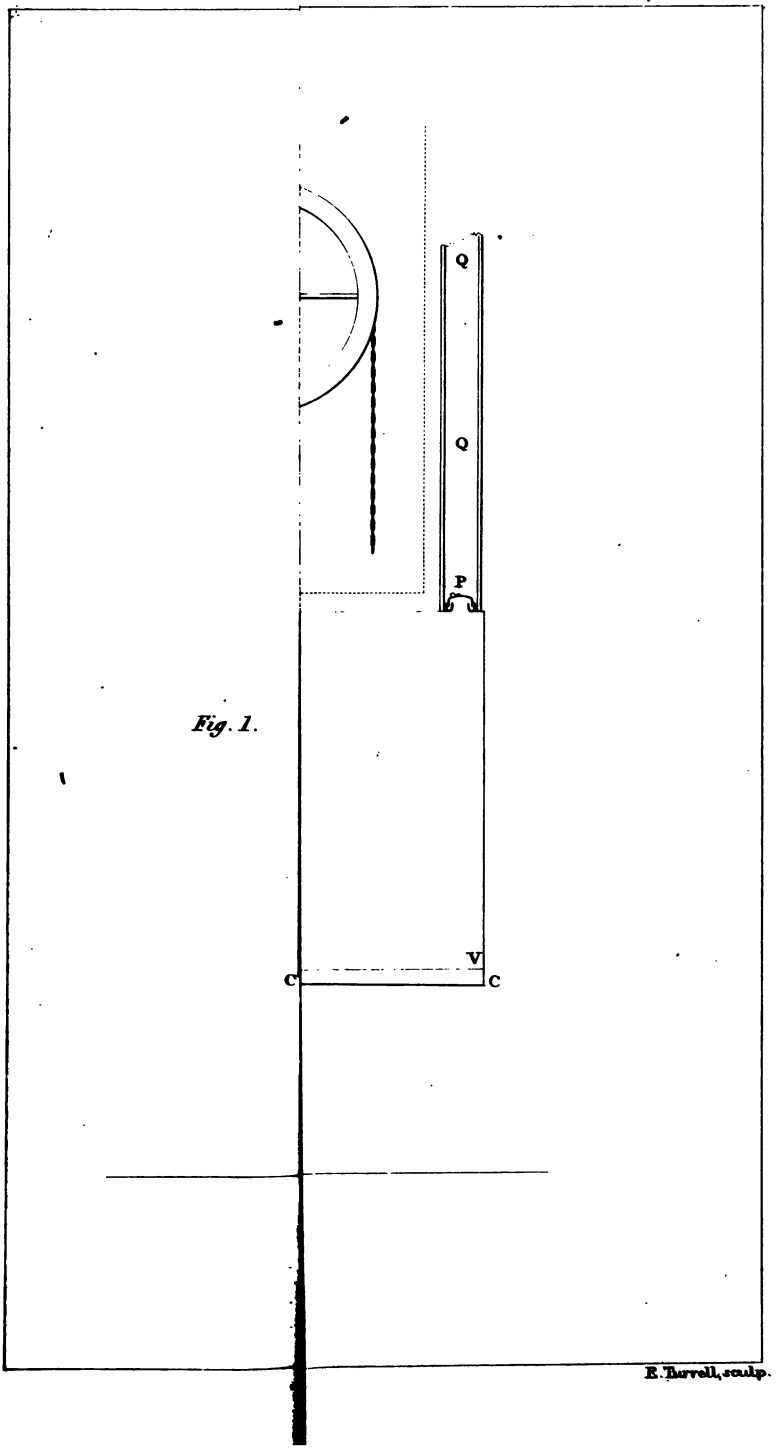

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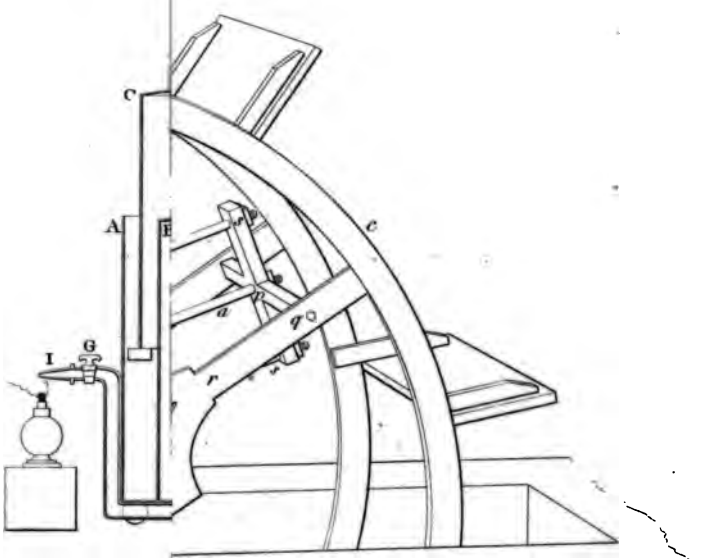

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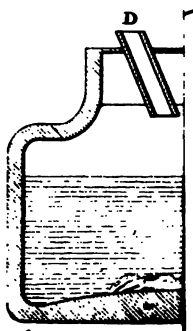

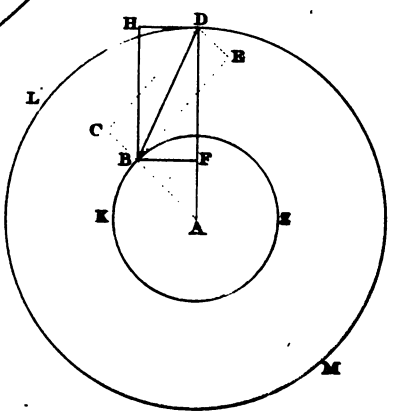

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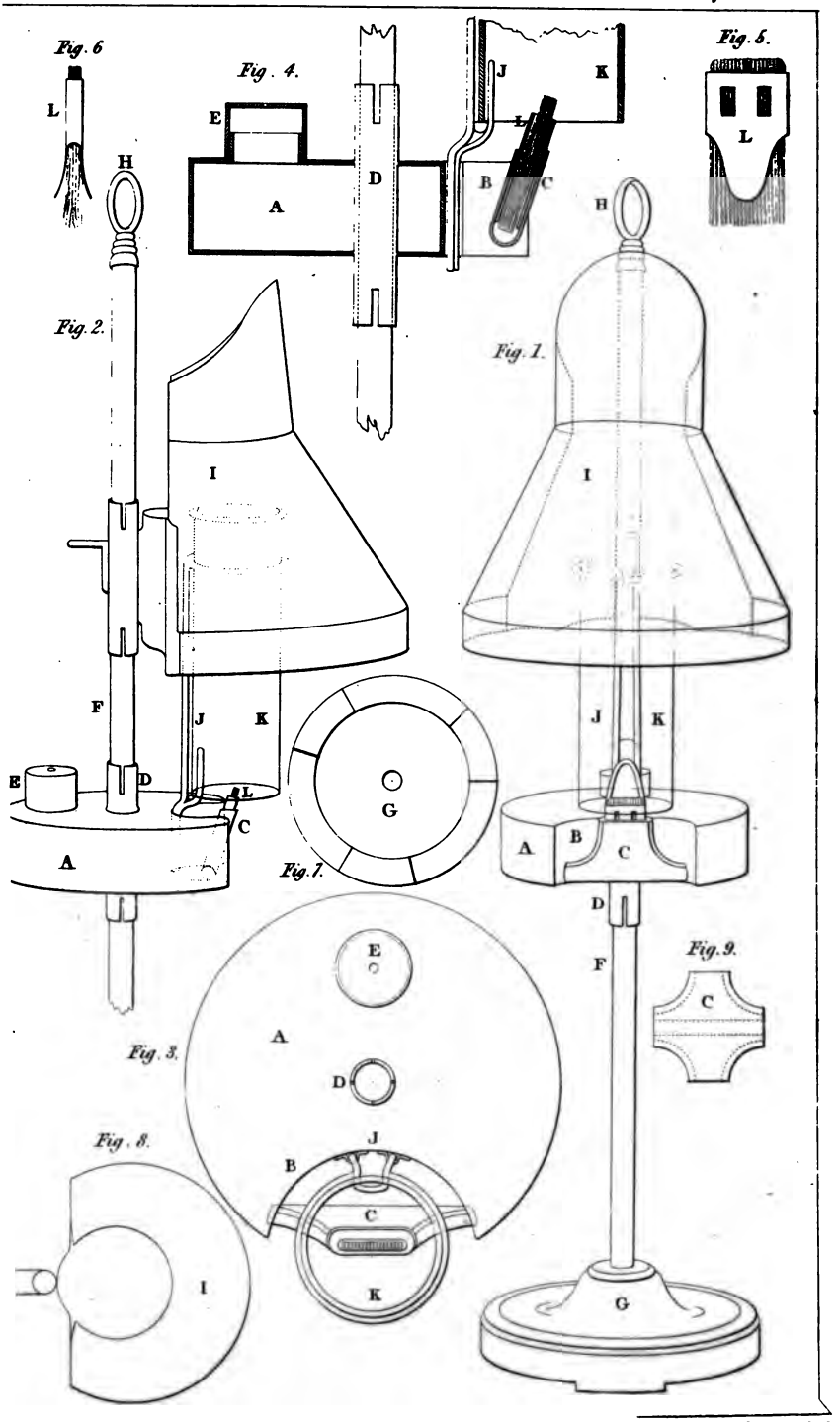
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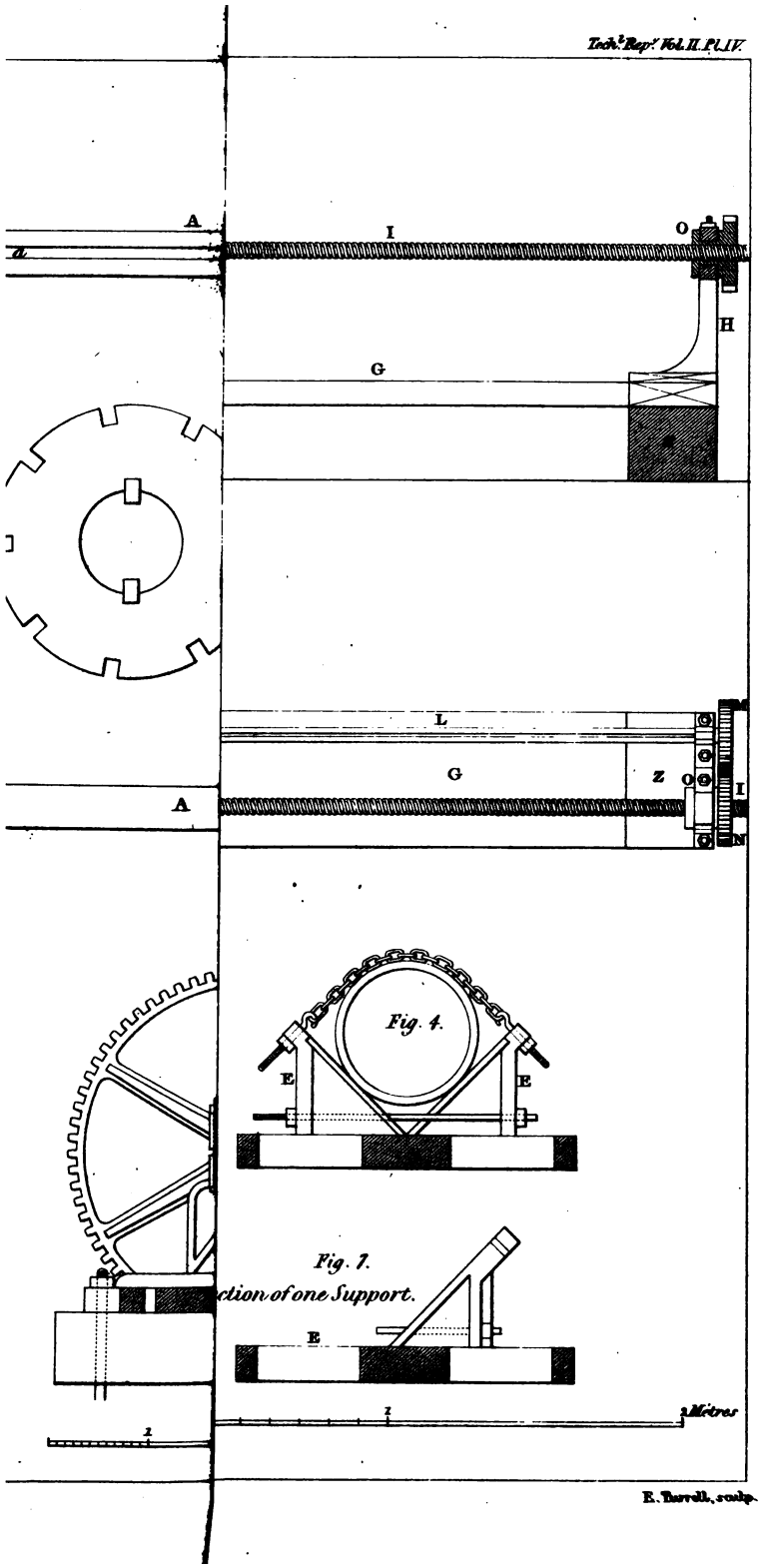

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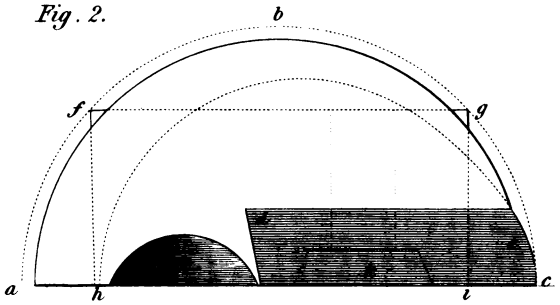

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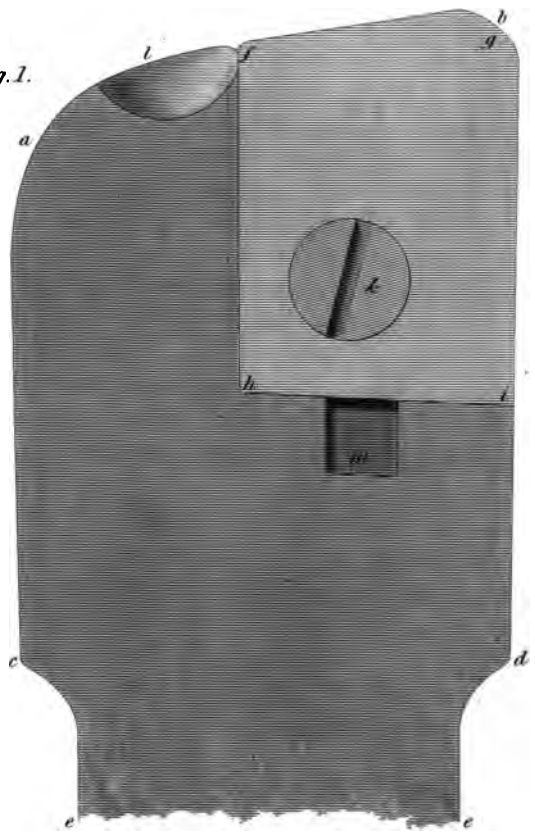

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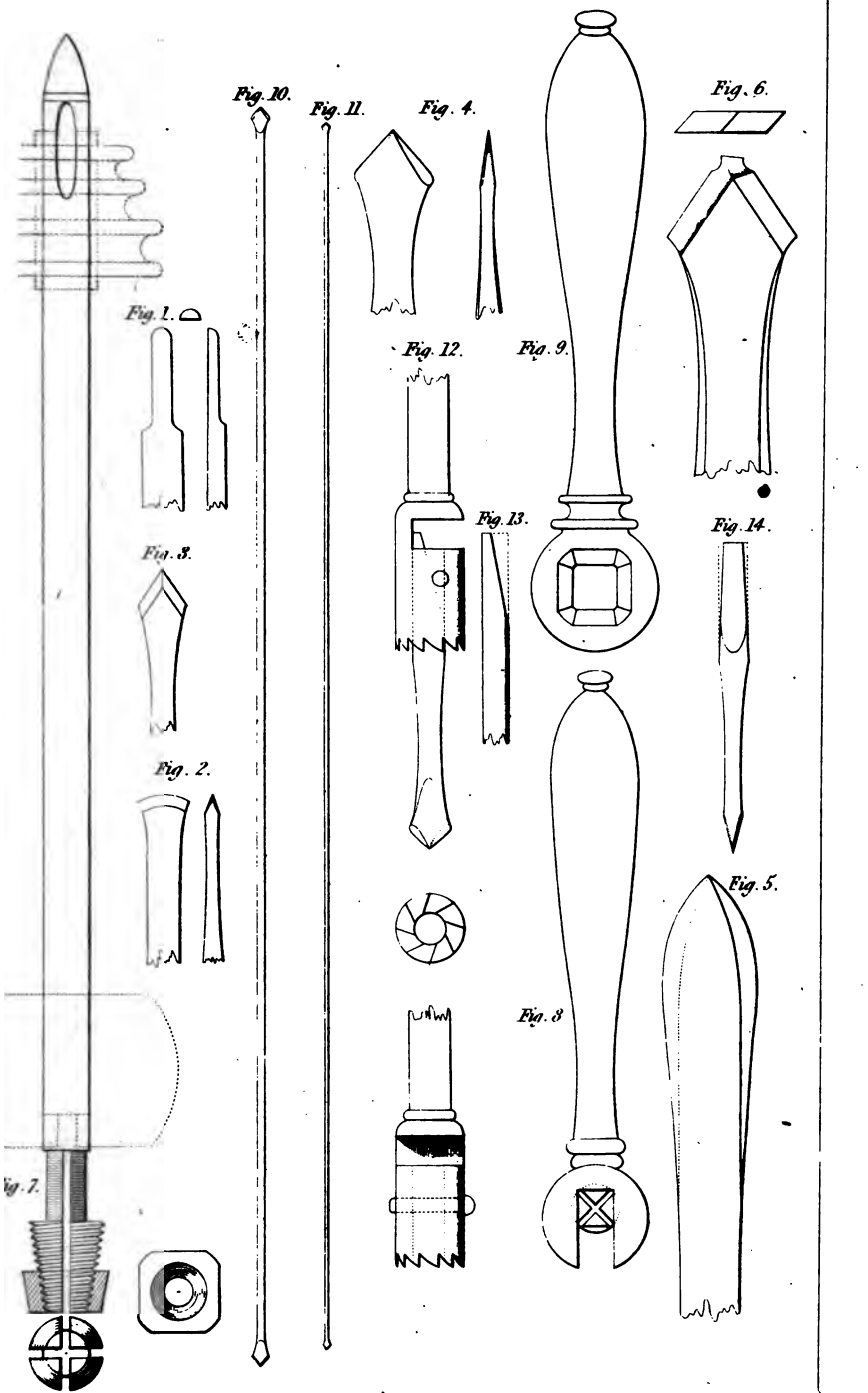
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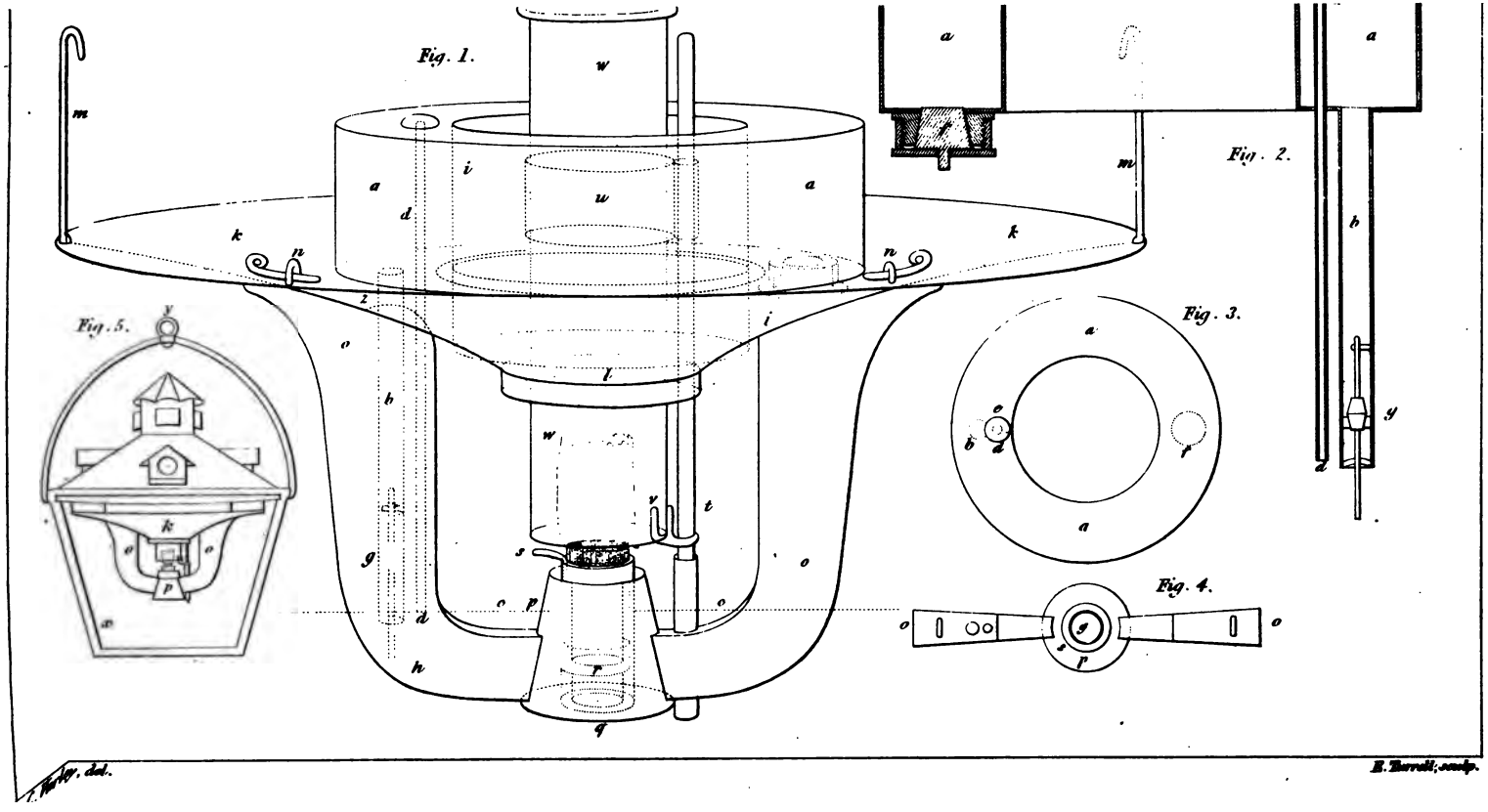
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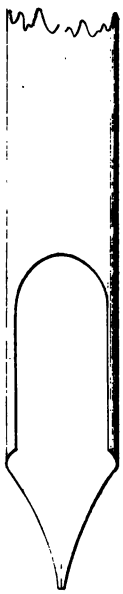
T. Taylor, del.
E. Turrell, sculp.

Fig. 1.



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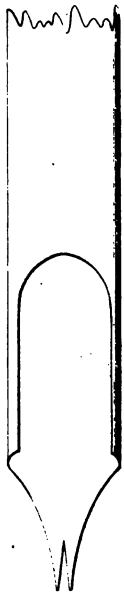

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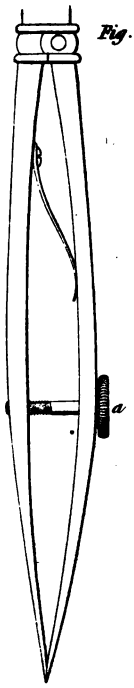

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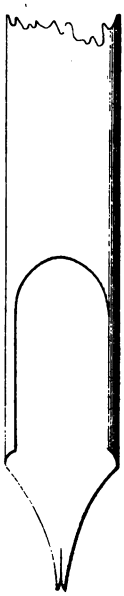

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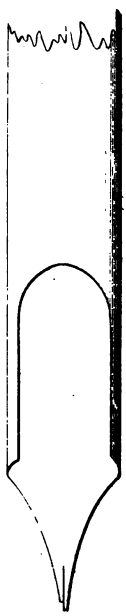

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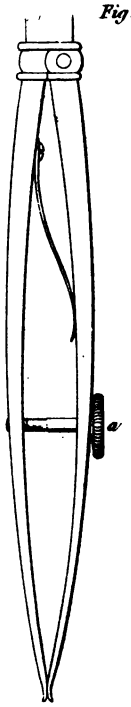
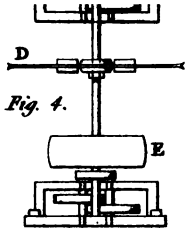


E. Turrell, sculp.



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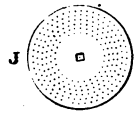

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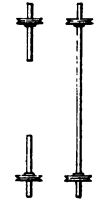

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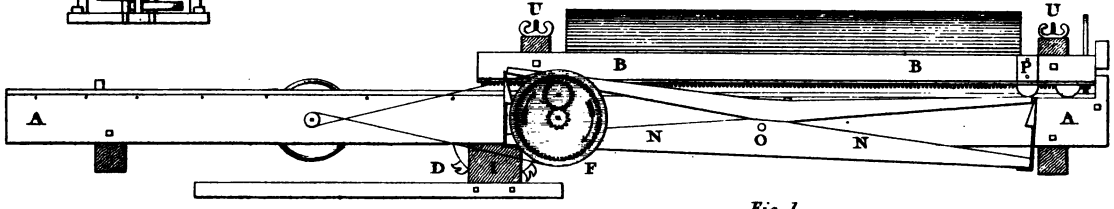

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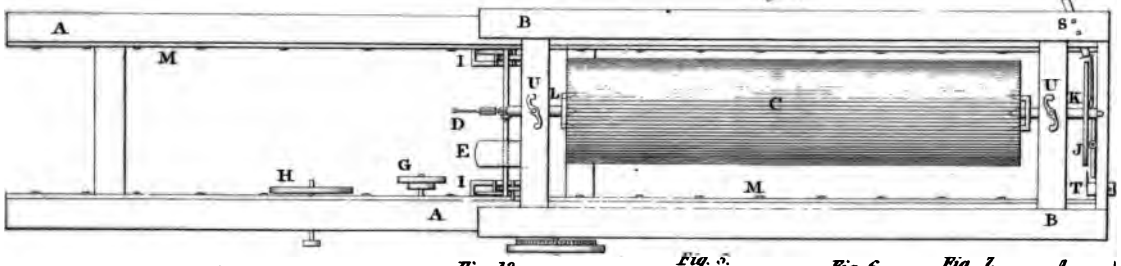

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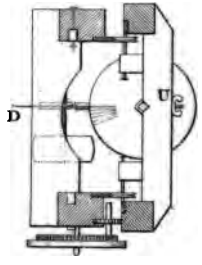

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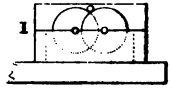

Fig. 5.

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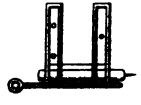

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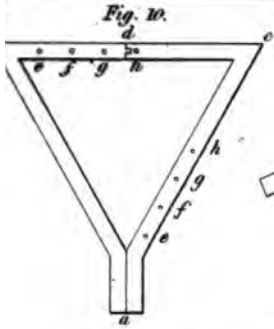

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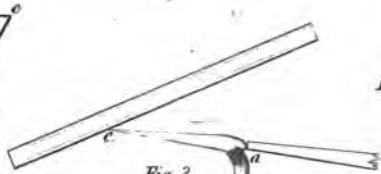

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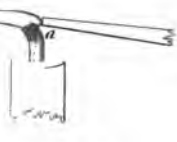

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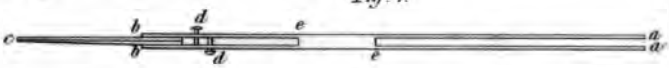

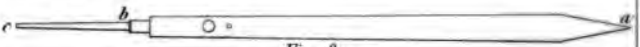

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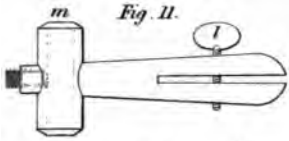

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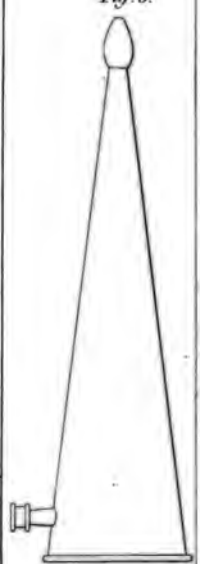

Fig. 14.

E. Turrell, sculp.

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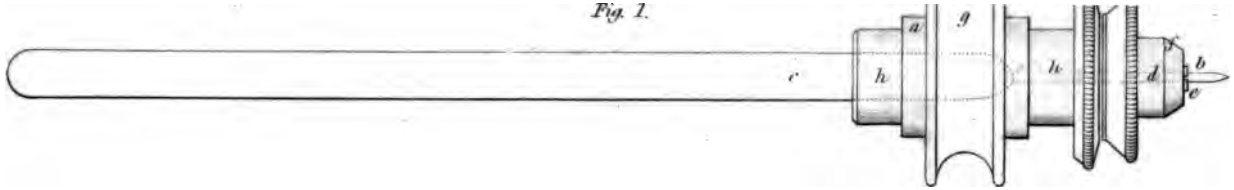

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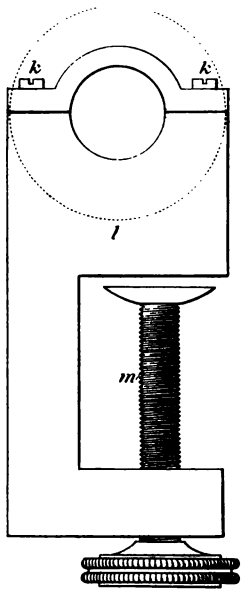

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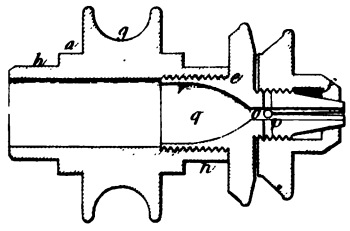

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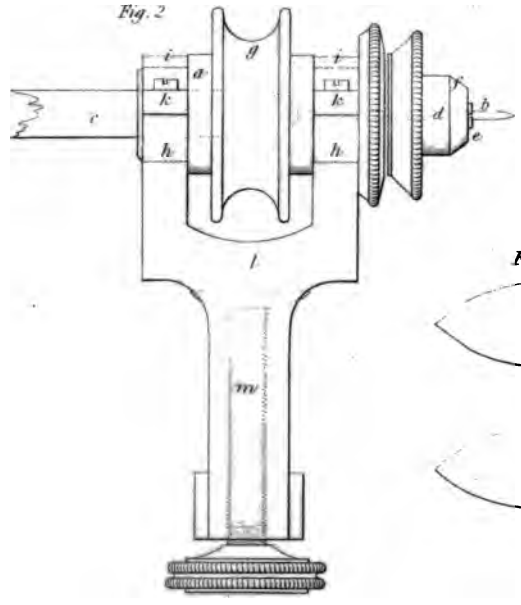

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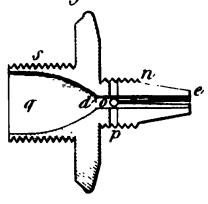

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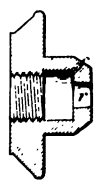

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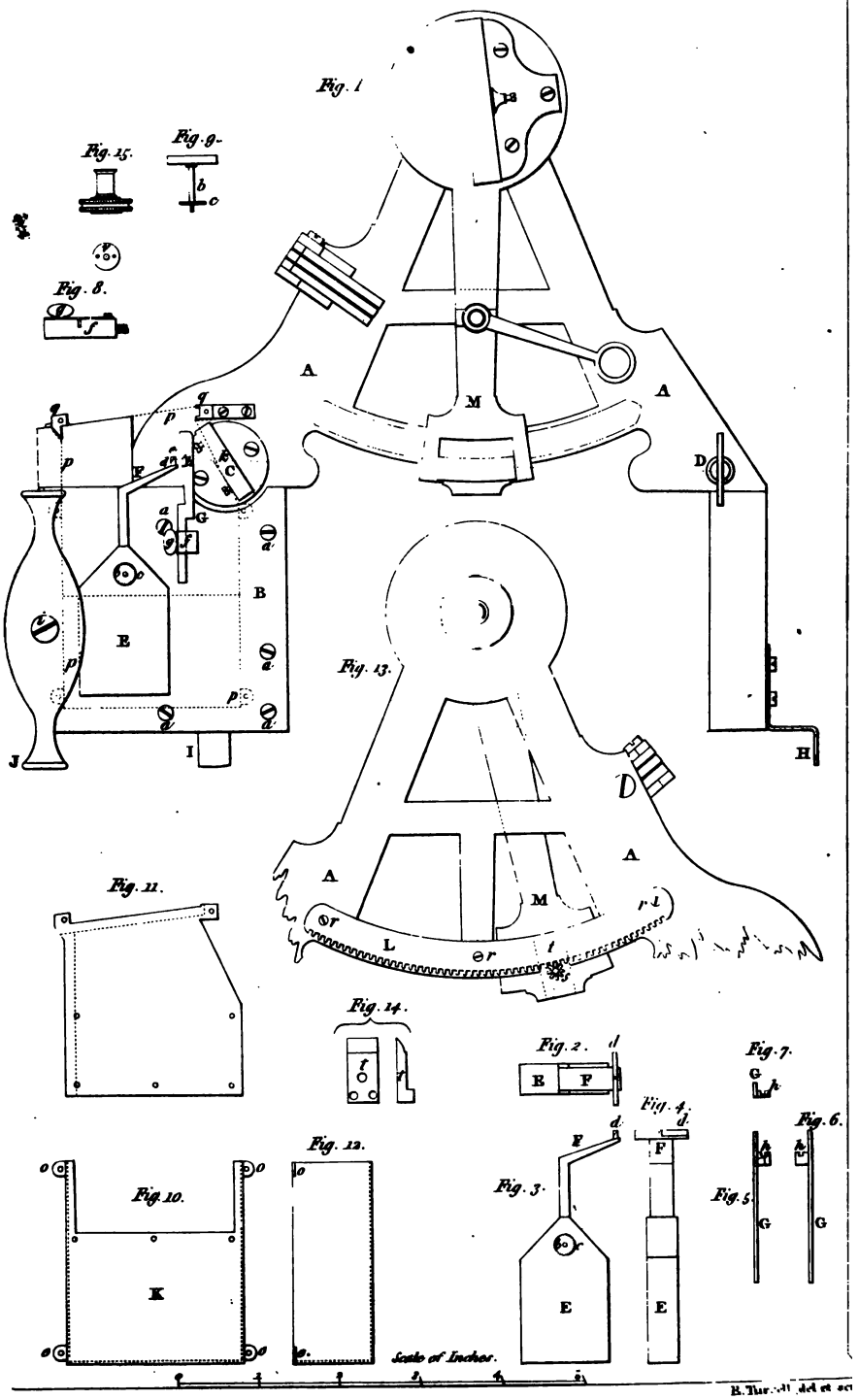
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Scale of Inches.

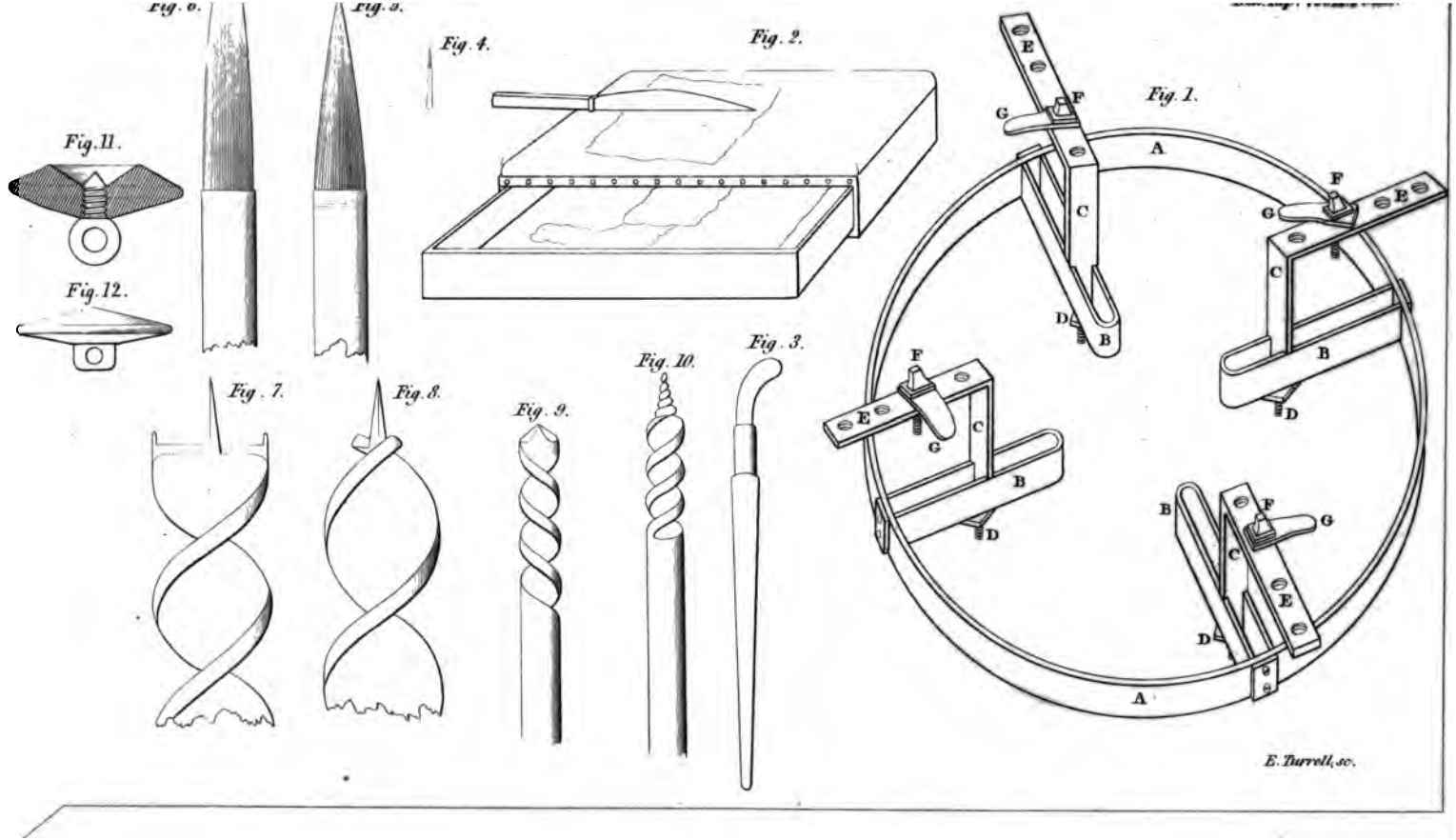
Fig. 6.
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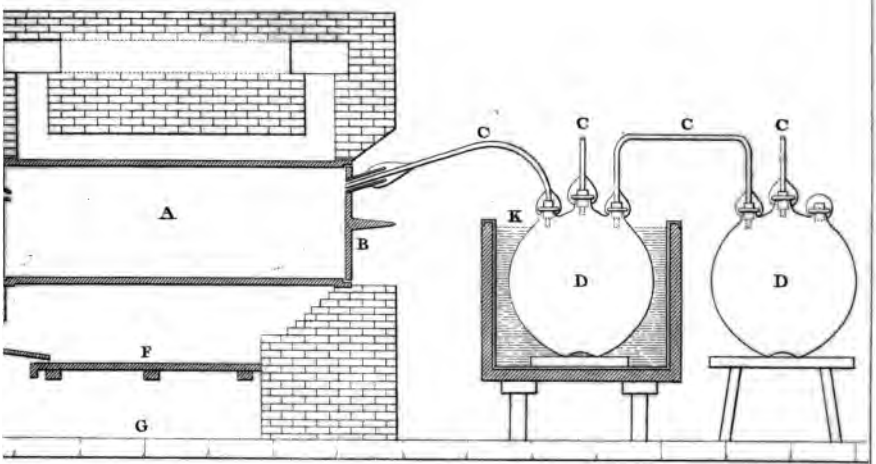
E. Turrell, sc.

Fig. 1.



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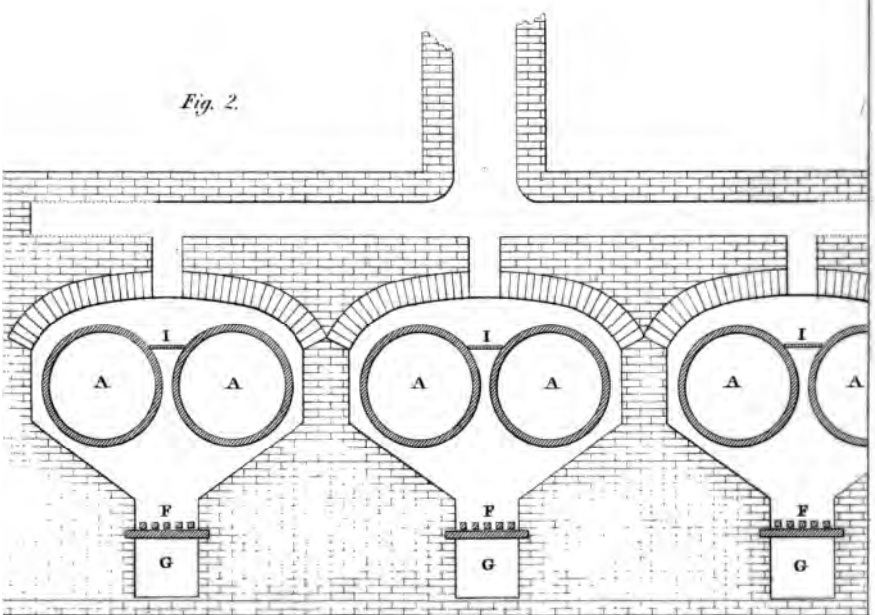

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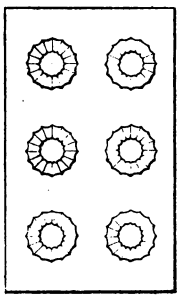

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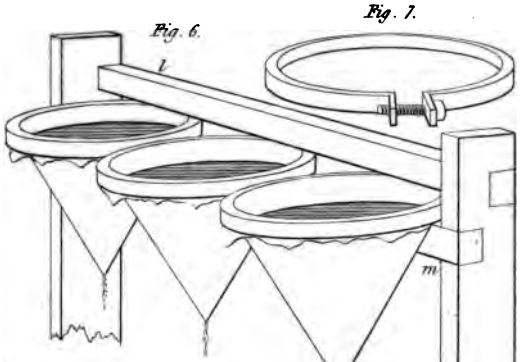

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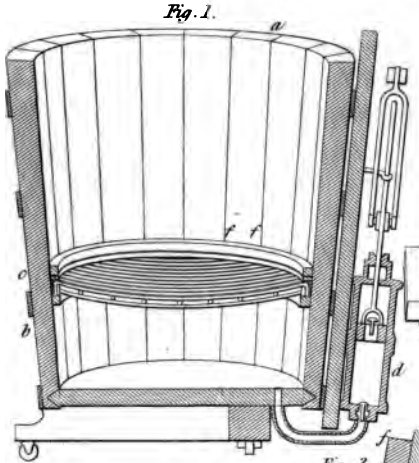

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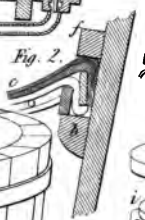

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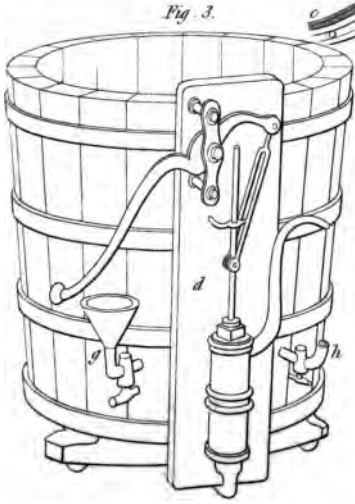

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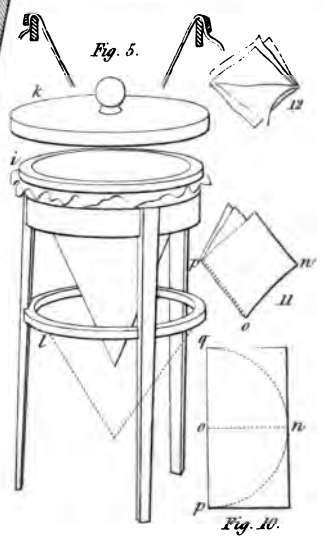

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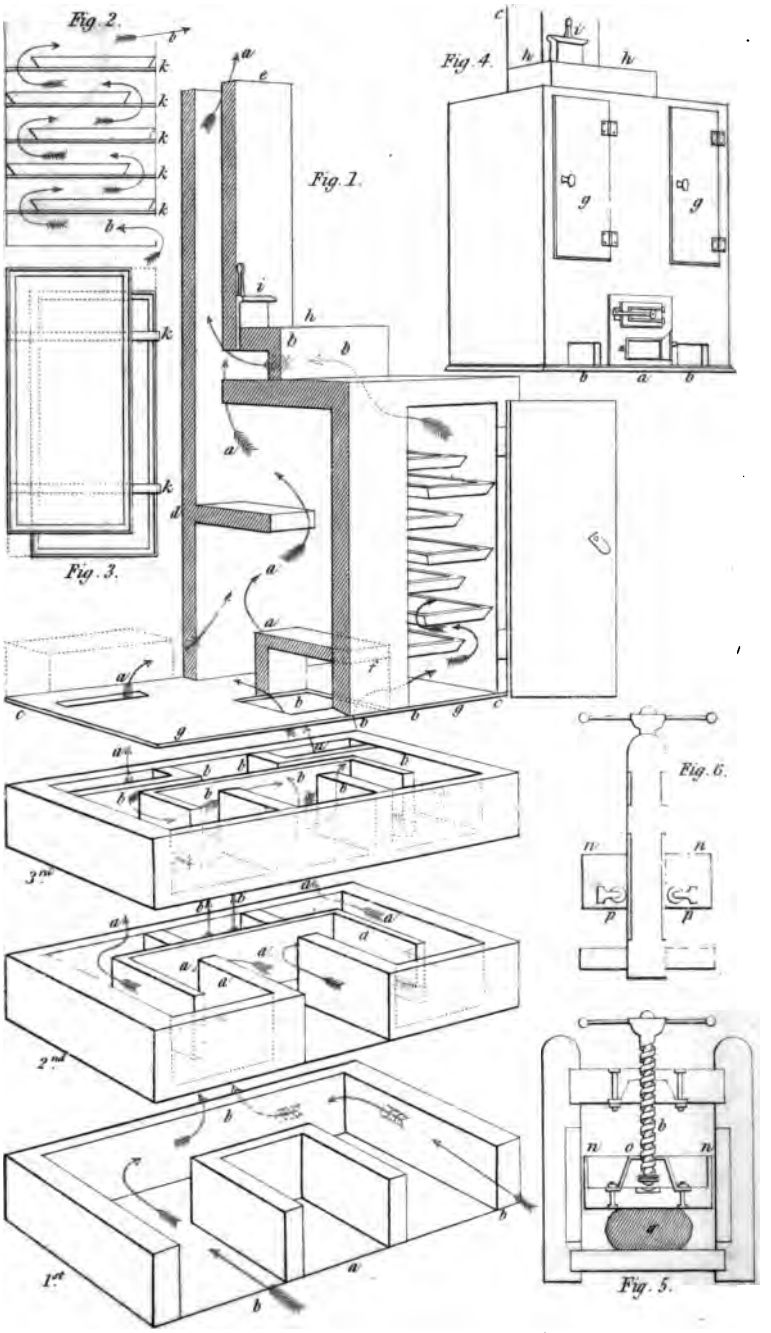
Fig. 2.
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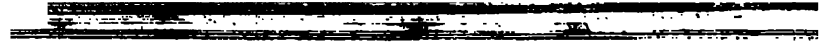

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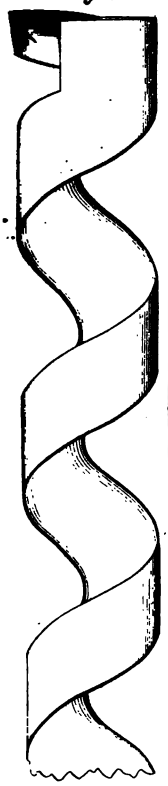

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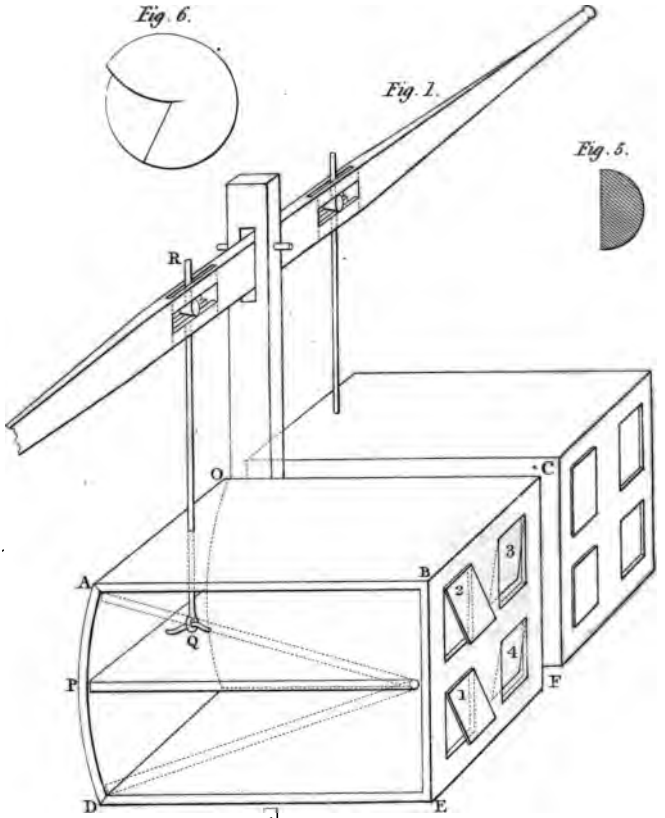

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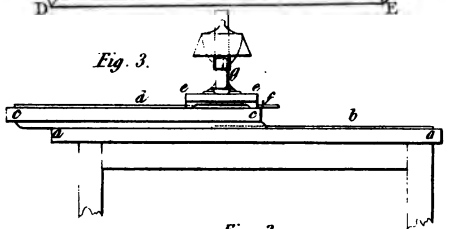
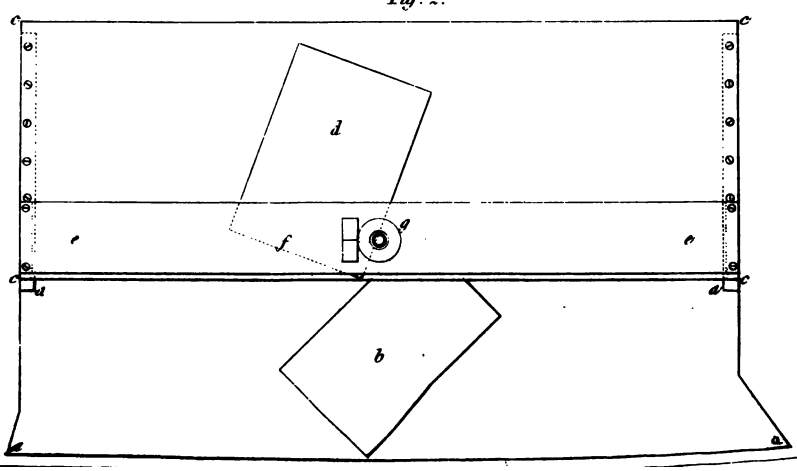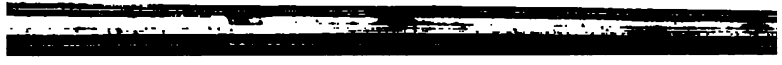
Fig. 2.